DIVISION 7 STORM DRAIN, CULVERTS, SANITARY AND COMBINED SEWERS, WATER MAINS AND RELATED STRUCTURES

SECTION 7-01 DRAINS

7-01.1 DESCRIPTION

Section 7-01 describes work consisting of constructing subsurface drains in accordance with *the Contract*. *This work* shall include installation of solid and perforated pipe, filter Material, filter fabric (geotextile), sidewalk drains, and gravel drains. Subsurface drains shall be constructed of gravel filter Material and may include perforated pipe and filter fabric as detailed on the Drawings.

7-01.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Gravel Backfill for Drains	9-03.12
Filter Material	9-03.12(4)
Joints, *Rubber Gaskets*	9-04.4
Pipe and Tubing	9-05
Geotextiles	9-05.22

Notes: Unless indicated otherwise in the Contract (all pipe sizes are inside diameter):

1. Corrugated Polyethylene Drainage Tubing Drain Pipe shall be limited to less than 10 inch.
2. Corrugated Polyethylene Drain Pipe shall be limited to 12 inch minimum to 36 inch maximum.
3. Perforated PVC Subsurface Drain Pipe shall be limited to a maximum 8 inch.

All reference to filter fabric shall be construed to mean a geotextile Material as specified in Section 9-05.22, Geotextile, Underground Drainage, Low Survivability, Class to be specified in Contract.

7-01.3 CONSTRUCTION REQUIREMENTS

7-01.3(1) EXCAVATION

Trenching is subject to the provisions of 7-17.3(1). *Work in excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems*.

A trench shall be excavated to the grade, line, and dimensions indicated on the Drawings. The subsurface drain pipe shall be installed with watertight rubber gasketed joint.

The subsurface drain trench shall be dug to the required alignment and grade only as far in advance of pipe installing as the Engineer will approve.

The clear width of trench measured at the springline of the pipe in place shall be 24 inches, or 1 foot greater than the outside diameter of the pipe, whichever is the greater. *Standard Plan no. 284 trench width is not applicable to drains.*

There shall be no mixing of filter Material with backfill Material. *See Section 2-03.3(10) regarding selected Material.*

7-01.3(2) PLACING PIPE AND FILTER MATERIAL

The filter Material for drain shall be damp when placed in the trench and shall be deposited uniformly on both sides of the pipe for the full width of the trench and to the springline of the pipe. The Material shall be tamped in 4-inch layers to provide thorough compaction under and on each side of the pipe. Succeeding layers of gravel shall be deposited in 8-inch layers and be thoroughly compacted to the depth shown on the Drawings.

The geotextile shall be placed in the manner and at the locations shown on the Drawings. The surface to receive the geotextile, and the trench into which the geotextile is to be placed, shall be free of obstructions and debris.

Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of geotextile of sufficient size to cover the damaged area including a minimum 12 inch overlap with all surrounding geotextile. In places where the trench width is less than 1 foot, the minimum overlap shall be the trench width.

The Contractor shall construct subsurface and sidewalk drains where indicated on the Drawings and in accordance with Standard Plan 241b unless the Contract specifies otherwise. Four inch galvanized steel pipe, or other pipe Material as indicated in the Contract, shall be placed under the sidewalk in 1 pipe length and extended across the planting area to the pavement gutter line at the face of curb. *Where curb exists or new curb is to be installed under the Contract, the curb side terminus of the drain pipe shall be encased in a 14-inch x 24-inch reinforced cement concrete curb block of the depth indicated in the Contract.*

Clearances between drains and other utilities shall be maintained per Section 1-07.17.

When it is necessary to intercept water flowing underneath the roadway surfacing, the subsurface drain shall be constructed in accordance with Contract.

All drain pipe shall be installed with the bell or larger end upstream.

All perforated pipe shall be installed with holes facing down. All slotted pipe shall be installed with the slots facing up. All drain pipes shall be open, clean, clear of debris, and free draining.

7-01.3(3) JOINTS

Polyvinyl chloride drain pipe shall be jointed with a bell and spigot joint using a flexible elastomeric seal as described in Section 9-04.8. The bell shall be installed upstream. Corrugated polyethylene drain pipe shall be jointed with snap-on, screw-on, or wraparound coupling bands as recommended by the manufacturer of the drain pipe.

7-01.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Filter Material, (Type)" will be per cubic yard based on the neat line cross section indicated on the Drawings.

Measurement for geotextile will be as specified in Section 2-12.4.

No Measurement will be made for the reinforced concrete curb block at the curb face.

Measurement for "Pipe, Subsurface Drain, (Material), (Size)" *and for* "Sidewalk Drain, 4-Inch, Type 281" will be by the linear foot measured along the centerline of the pipe from pipe end to pipe end.

7-01.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-01 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Pipe, Subsurface Drain, (Material), (Size)",** per linear foot.

The *Bid item price* for "Pipe, Subsurface Drain, (Material), (Size)" shall include all costs for the work required to furnish and install the pipe, excavate the pipe trench, haul and dispose of excess excavated Material.

2. "**Filter Material, (Type)",** per cubic yard.

The *Bid item price* for "Filter Material, (Type)" shall include all costs for the work required to furnish, install, and compact the Mineral Aggregate filter Material specified on the Drawings, and shall also include, when the subsurface drain is constructed of only gravel filter Material, the costs of the work required to excavate the trench and to haul and dispose of excess excavated Material.

3. "**Sidewalk Drain, (Size), (Material)"**, per linear foot.

The *Bid item price* for "Sidewalk Drain, (Size), (Material)" shall include all costs for the work required to furnish and install the drain pipe with intake screen and the reinforced concrete curb block, excavation and backfill, saw cut and remove the existing curb. It shall also include excavation at the inlet end of the pipe to make a gravel drain that has minimum dimensions of 12 inch wide by 12 inch deep by 3 feet in length.

4. "**Gravel Drain, (Type)**", per linear foot.

The *Bid item price* for "Gravel Drain, (Type)" shall include all costs for the work required to excavate a trench 12 inches wide, fill it with Mineral Aggregate filter Material to a depth of 12 inches, haul and dispose of excess excavated Material and backfill trench with suitable excavated Material.

5. **Other payment information**.

Any part of the trench excavated below grade or to a greater width than specified *in the Contract* shall be backfilled with filter Material as specified *in the Contract* at the Contractor's sole expense.

Payment for geotextile will be in accordance with Section 2-12.5.

SECTION 7-02 CULVERTS

7-02.1 DESCRIPTION

Section 7-02 describes work consisting of constructing Culverts of the various types and classes indicated in the Standard Plans, and at locations and as otherwise indicated in the Contract.

Culvert work in ditches and channels over 4 feet deep are subject to Trench Safety Systems, Section 7-17.3(1)A7a.

7-02.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Mortar and Grout	9-04.3
Pipe	9-05
Junction Box	*9-12.9*

Where steel or aluminum Culvert pipe, pipe arch, or end sections are referred to in this Section, it shall be understood that steel is zinc coated (galvanized) or aluminum coated (aluminized) corrugated iron or steel, and aluminum is corrugated aluminum alloy as specified in Sections 9-05.4 and 9-05.5.

The class of concrete pipe, or the thickness of steel or aluminum pipe, or pipe arch shall be the same for the entire length of the Culvert, and shall be required using as a basis the maximum height of cover indicated on the Drawings.

Beveled end sections shall be of the same Material as the Culvert pipe to which they are attached.

Box Culvert shall be in accordance with the Drawings.

7-02.3 CONSTRUCTION REQUIREMENTS

7-02.3(1) PLACING CULVERT PIPE

7-02.3(1)A GENERAL

A trench shall be excavated to the alignment, depth, and grade shown on the Drawings. Excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

Proper preparation of foundation, placement of foundation Material where required, and placement of the first lift of bedding Material shall precede the installation of all Culvert pipe. This shall include necessary leveling of the native trench bottom, or leveling the top of the foundation Material where required, as well as placement and compaction of required backfill Material to a uniform grade so that the entire length of pipe is uniformly supported on a uniformly dense and unyielding base.

Material meeting the requirements of gravel backfill for pipe bedding, when required in the Contract, shall be placed under the pipe and along the sides of the pipe in accordance with Standard Plan no. 285. Bedding shall be placed in two or more lifts. The first lift shall be placed, spread, and compacted to a uniform thickness of 4 inches or 6 inches (as indicated on Standard Plan no. 285) before the pipe is installed so that the pipe is uniformly supported along the barrel. Subsequent lifts of pipe bedding, of not more than 6 inches in thickness, shall be placed and compacted along the sides to the height shown in Standard Plan no. 285. Lifts shall be brought up evenly on both sides of the pipe and shall be worked carefully under the pipe haunches and then compacted. *If the Engineer determines that the Material existing in the bottom of the trench is acceptable for bedding the pipe, gravel backfill for pipe bedding will not be required. In this case, the existing native Material shall be loosened and stockpiled for reuse as bedding, and the bottom regraded and compacted to form a dense and unyielding base*.

When indicated in the Contract, a dike or plug of impervious Material shall be placed near the intake end of the Culvert to prevent piping. The dike shall be 2 feet long and adequately placed around the pipe into native material to form an impervious barrier. *When suitable impervious Materials are not available at the site, suitable backfill shall be obtained as provided in Section 2-09.3(1)E.*

Where pipe is to be placed in a new embankment, the embankment shall be constructed for a distance each side of the pipe location of not less than five times the diameter of the pipe and to a minimum height above the pipe equal to 1/2 the outside diameter of the pipe. The embankment Material shall be compacted to 95 percent of maximum density, and the moisture content at the time of compaction shall be between optimum and 3 percentage points below optimum as determined by the Compaction Control Tests specified in Section 2-03.3(14)E. The trench shall then be excavated to a width as indicated in Standard Plan no. 284 and the pipe installed and backfill compacted in accordance with Section 7-17.3(3).

The ends of the pipe, box or pipe arch shall be rigidly supported to prevent movement before and during the construction of end walls or headers.

Culverts shall not extend beyond the staked limits.

Culvert pipe shall be constructed within the same tolerance limits as specified for Sewer pipes in Section 7-17.3(2)B.

In excavation for Culverts, if any part of the excavated Materials meets the Specifications of Section 9-03.12(3), the Engineer may require that such Material, in the quantity required, be selectively removed, stockpiled separately, and used as pipe bedding in place of gravel backfill for pipe bedding. If Material so stockpiled becomes contaminated, the Contractor shall furnish suitable Material in an amount equal to that lost by contamination at no expense to the Owner.

All Culverts and end sections shall be open, clean, and free draining.

If the Contractor proposes an alternate pipe installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval prior to procuring or constructing the alternate.

Pipe installed under side Road connections, where the depth of cover is less than 2 feet, shall not be of the bell and spigot type, but shall have beveled ends.

7-02.3(1)B PLACING CONCRETE PIPE

7-02.3(1)B1 GENERAL

In the trench, concrete pipe shall be installed beginning at the lower end, with the bell or groove end up grade. For pipe with elliptical reinforcement, the minor axis of reinforcement shall be in a vertical position.

When it is necessary to connect dissimilar pipe, an adapter coupling shall be used as detailed on the Drawings.

7-02.3(1)B2 RUBBER GASKETED JOINTS

In installing concrete pipe with rubber gaskets, the bottom of the trench shall be dewatered, firm, and free of loose Material so that joining can be accomplished without contaminating the joint with soil or other deleterious Material.

Pipe with affixed gaskets shall be handled carefully to avoid knocking the gasket out of position or contaminating it with foreign Material. Any gasket so disturbed shall be removed, cleaned, relubricated if required, and replaced before joining the pipe sections.

The pipe shall be properly aligned before joints are forced home. Sufficient pressure shall be applied in making the joint to ensure that the joint is home, as defined in the standard installation instructions provided by the pipe manufacturer. The Contractor may use any method recommended by the pipe manufacturer and acceptable to the Engineer for pulling the pipe together, except that driving or ramming by hand or machinery will not be permitted. Any pipe damaged during joining and joint tightening shall be removed and replaced at no expense to the Owner.

Sufficient restraint shall be applied to the line to ensure that joints once home remain undisturbed. At the end of the Day's work, the last pipe section shall be braced to prevent creep.

7-02.3(1)B3 HAND MORTARED JOINTS

On bell and spigot type pipe, the lower portion of the bell shall be filled with stiff mortar, composed of one part Portland cement and three parts fine sand and shall be sufficiently thick to make the inner surfaces of the abutting sections flush and even as the pipe is installed. On tongue and groove pipe, the lower 1/2 of the groove and the upper 1/2 of the tongue shall be coated with a thin layer of mortar composed of one part Portland cement and two parts fine sand. The use of aluminum powder or calcium chloride in any mortar will not be allowed. After covering the ends with mortar, the spigot end (or tongue end) shall be inserted into the bell (or groove) as far as the construction of the pipe permits.

After each section of the pipe is installed, uniformly matched, and the sections fitted as close as the construction of the pipe permits, the joint, both inside and out, shall be filled and sealed with the mortar mix as specified in the previous paragraph. After sealing, the joint on the inside of the pipe shall be cleaned of all surplus mortar and smoothed flush to match the shape of surrounding surface. The mortar outside the pipe shall be properly cured by covering with polyethylene sheeting, damp sand, or spraying with curing compound; the Culvert shall not be backfilled until the mortar has set for at least 24 hours.

7-02.3(1)B4 ELLIPTICAL REINFORCEMENT

In lieu of marking circular pipe with elliptical reinforcement in accordance with ASTM C 76, the location of the top of the pipe shall be indicated by 3-inch wide, waterproof, painted stripes on the inside and outside of the pipe for a distance of 2 feet from each end of the *pipe* section.

7-02.3(1)C PLACING STEEL OR ALUMINUM PIPE

7-02.3(1)C1 GENERAL

Metal pipe and metal pipe arch shall be placed in a trench prepared as specified in Section 7-02.3(1)A. Separate sections of the pipe shall be installed in the trench with the outside laps of circumferential joints upgrade and with longitudinal laps positioned other than in the invert, and firmly joined together with approved bands.

7-02.3(1)C2 INSTALLATION OF METAL END SECTIONS

7-02.3(1)C2a GENERAL

Metal end sections shall be installed in accordance with WSDOT Standard Plan nos. B-7 and B-7a.

7-02.3(1)C2b RESERVED

7-02.3(1)C2c MITERED ENDS

The ends of steel Culvert pipe or pipe arch shall not be beveled unless specified otherwise in the Contract. If beveled ends are specified, the ends of Culvert pipe over 30 inches in diameter shall be mitered to conform to the slope of the embankment in which the Culvert is to be placed whether the Culvert is constructed normal to or at an angle with the centerline of the Roadway.

Beveled steel pipe end sections 12 inches through 30 inches in diameter shall be of the same Material and thickness and have the same protective coating as the pipe to which they are attached. Beveled pipe ends of these dimensions shall be constructed in conformance with WSDOT Standard Plan no. B-7a.

7-02.3(1)C3 PROTECTIVE TREATMENT

7-02.3(1)C3a TREATMENT OF STEEL PIPE

Steel pipe and pipe arch Culverts shall be coated by one of the following protective treatments, when such treatment is required in the Contract:

Treatment 1	Coated uniformly inside and out with asphalt.
Treatment 2	Coated uniformly inside and out with asphalt and with an asphalt paved invert.
Treatment 3	Coated inside & out with fibers embedded in the spelter coating, then covered on both sides with asphalt.
Treatment 4	Coated as in Treatment 3 and with an asphalt paved invert.
Treatment 5	Coated inside and out with asphalt and a 100 percent periphery inside spun asphalt lining.
Treatment 6	Coated as in Treatment 3 and with a 100 percent periphery inside spun asphalt lining.

7-02.3(1)C3b TREATMENT OF ALUMINUM PIPE

When plain aluminum pipe or pipe arch is used where it makes contact with concrete or concrete pipe, all aluminum surfaces in contact with, and to 1 foot beyond the contact zone with the concrete or concrete pipe shall be cleaned and painted with two coats of paint. The aluminum pipe to be painted shall be cleaned with solvent to remove contaminants. After cleaning, the pipe shall be painted with two coats of paint conforming to Federal Specification TT-P-645 (Primer, Paint, Zinc Chromate, Alkyd Vehicle).

7-02.3(2) JUNCTION BOX

Junction boxes shall be only used where private storm service drain, or other small diameter storm pipe, needs to be connected with an existing Culvert. Sanitary, or combined storm and sanitary, connections will not be allowed with a Culvert system or with a junction box to a Culvert system. Junction box shall be installed as shown on the Drawings. See Standard Plan no. 277 and Section 9-12.9.

7-02.3(3) BACKFILLING

Placement and compaction of backfill Material above the bedding zone shall be performed in accordance with the requirements specified in Section 7-17.3(3) Backfilling Trenches.

The Contractor shall not operate tractors or other heavy Equipment over the Culvert until it has been backfilled as provided above, or until the embankment has reached a height of 2 feet above the top of the Culvert, or as provided in Section 1-07.7 if the site of the Culvert is at a location where legal Highway load limitations are not in effect.

7-02.3(4) REMOVING AND REINSTALLING CULVERTS

In the case of concrete pipe, all joints of the pipe before being reinstalled shall be cleaned so as to be free from all adhering Materials, including old mortar placed as a collar or seal in the original construction.

All Culvert sections removed and not reinstalled shall become the property of the Contractor.

7-02.3(5) PLUGGING EXISTING CULVERTS

Where shown on the Drawings, existing Culverts shall be plugged on the inlet end as specified in Section 2-02.3(5). Culvert to be abandoned and filled shall be as specified in Section 2-02.3(5).

7-02.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for Junction Box will be per each.

Measurement of Culvert pipe, box Culvert, or pipe arch Culvert will be the number of linear feet of completed installation measured along the invert.

Measurement of beveled end sections will be considered as part of the Culvert pipe, box Culvert, or pipe arch Culvert and will be measured as part of Culvert pipe, box Culvert, or pipe arch Culvert.

Embankment construction before Culvert placement under the applicable provisions of Section 7-02.3(1) will be measured in accordance with Section 2-03.

7-02.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-02 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Pipe, Culvert, (Material), (Class), (Size)",** per linear foot.
2. "**Pipe Arch, (Material), (Class), (Size)",** per linear foot.

The *Bid item prices* for "Pipe, Culvert, (Material), (Class), (Size)" and for "Pipe Arch, (Material), (Class), (Size)" shall include all cost for the work required to furnish and install Culvert pipe and pipe arch, as specified in Section 7-02 including beveled end sections when required and final cleaning of the Culvert.

*3. "**Junction Box**", per each.*

The Bid item price for "Junction Box" shall include all cost for the work required to furnish and install the junction box complete to finish grade including but not limited to excavation, mortar, grout, brick, block, castings, and backfill with suitable native material.

4. **Other payment information**.

Where Culvert pipes are to be removed *and* are not to be reinstalled, see Section 2-02.5 for payment.

No payment will be made for plugging existing pipes. See Section 2-02.5.

Alternate pipe installations to that shown on the Drawings and approved by the Engineer shall have no increase in the *Bid item price* to the Owner.

All costs involved in storing, protecting, re-handling, disposing, and/or placing the excavated Material shall be included in the applicable Bid items of Work.

All costs of cleaning and painting aluminum pipe surfaces as specified in Section 7-02.3(1)C3b shall be included in the Bid item price for the aluminum pipe or pipe arch.

Payment for Section 7-02.3(1)C3a treatment shall be incidental to the Bid item price for the aluminum pipe or pipe arch and no separate or additional payment will be made therefore.

Payment for trench safety systems, when applicable, will be as specified in Section 7-17.5.

SECTION 7-03 STRUCTURAL PLATE PIPE, PIPE ARCH, ARCH, AND UNDERPASS

7-03.1 DESCRIPTION

Section 7-03 describes work consisting of constructing structural plate pipe, pipe arches, arches, and underpasses of various types and designs in accordance with WSDOT Standard Plan nos. B-8 and B-8a, and as specified in Contract, and at the locations and grades indicated on the Drawings.

Structural plate pipes shall be full circle of the type, gauge or thickness, and diameter specified in the Contract. Structural plate pipe arches shall be a multi-centered shape made up of four circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the type, gage or thickness, and span specified in the Contract.

Structural plate arches shall be a single-centered circular arc shape, placed on a reinforced concrete foundation, and of the design, type, gage or thickness, and span as provided for in *the Contract*.

Structural plate underpasses shall be a multi-centered shape made up of a variable number of circular arcs tangent to each other at their junctions and symmetrical about the vertical axis and of the design, type, gage or thickness, and span specified *in the Contract*.

Structural plate pipe, pipe arches, arches, and underpass work in ditches, channels, and trench excavations over 4 feet deep are subject to the provisions of Section 7-17.3(1)A7a, Trench Safety Systems.

7-03.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Concrete Class B	6-02.3
Pipe, Pipe Arch, Arch, and Underpass	9-05.6
Reinforcing Steel	9-07

Bolts and bolted connections shall conform to AASHTO M 167 for steel and to AASHTO M 219 for aluminum.

7-03.3 CONSTRUCTION REQUIREMENTS

7-03.3(1) FOUNDATIONS

7-03.3(1)A GENERAL

Structural plate pipes, pipe arches, underpasses, and bases for arches shall be placed on stable foundations prepared to the widths, depth, and grade as shown on the Drawings. Soft spots encountered in the foundation shall be excavated to a depth, and backfilled and compacted with Material as indicated in the Contract.

Rock, in either ledge or boulder formation, hard pan, or cemented gravel occurring in the base material shall be excavated below grade and backfilled with suitable Material to provide a minimum 8-inch cushion under the pipes, pipe arches, or underpasses.

Concrete required for constructing structural plate arch foundations shall be Class B concrete in conformance with the requirements of Section 6-02.3.

Steel reinforcing bars shall conform to the requirements of Section 9-07.

7-03.3(1)B STRUCTURAL PLATE PIPE, PIPE ARCH, AND UNDERPASS

The foundation for structural plate pipes, pipe arches, and underpasses, shall be shaped to conform to their bottom form, and shall form firm and uniform bearing throughout their length. Where pipes, pipe arches, or underpasses are to be installed in new embankment, the embankment shall be constructed to the 1/3-point of structural plate pipes (measured from the invert of the pipe), to the height of maximum horizontal dimension of structural plate pipe arches as provided for in WSDOT Standard Plan nos. B-8 and B-8a, and in the case of a special design, as indicated on the Drawings, after which the trench shall be excavated and installation made.

The ends of structural plate pipes, pipe arches, arches, or underpasses, shall not be mitered unless indicated otherwise in the Contract. If mitered ends are specified, the slope shall conform to the slope of the embankment in which the Culvert is to be placed and shall be limited to the top arc only.

7-03.3(1)C STRUCTURAL PLATE ARCH

The base for structural plate arches shall be as shown *on the Draw*ings.

7-03.3(2) ASSEMBLING

Structural plate pipes, pipe arches, arches, and underpasses shall be assembled in place in accordance with the manufacturer's instructions, which shall accompany the shipment of Materials and show the position of each plate and the order of assembly. The Contractor shall submit the manufacturer's instructions at least 5 Working Days prior to construction.

7-03.3(3) BACKFILLING

After the structural plate pipe, pipe arch, arch, or underpass has been placed in position, it shall be backfilled in accordance with Section 7-02.3(3).

7-03.3(4) FOUNDATION TREATMENT

Earth, or other Material when specified *in the Contract*, shall be placed and compacted beneath structural plate pipes, pipe arches, or underpasses in conformance with WSDOT Standard Plan no. B-11.

7-03.3(5) HEADWALLS

If headwalls are specified *on the Draw*ings, they shall be constructed as soon as the embankment has been completed to a sufficient height over the structure to allow the required work. Headwalls shall be constructed in accordance with the applicable portions of Section 6-02.

7-03.3(6) ALTERNATE INSTALLATION

If the Contractor proposes an alternate installation, Shop Drawings for the alternate shall be submitted to the Engineer for approval at least 10 Working Days prior to procuring or constructing the alternate.

7-03.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement of structural plate pipes, pipe arches, arches, and underpasses, will be the number of linear feet of completed installation measured along the invert.

Concrete will be measured by the cubic yard as specified in Section 6-02.4.

Steel reinforcing bars will be measured by the pound as specified in Section 6-02.4.

Structure excavation will be measured by the cubic yard as specified in Section 2-09.4.

Gravel backfill for foundation will be measured by the cubic yard as specified in Section 2-09.4.

7-03.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-03 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Structural Plate Pipe, (Material), (Thickness), (Diameter)",** per linear foot.
2. "**Structural Plate Pipe Arch, (Material), (Thickness), (Span)",** per linear foot.
3. "**Structural Plate Arch, (Material), (Thickness), (Span)",** per linear foot.
4. "**Underpass, (Design), (Thickness), (Span)",** per linear foot.

The Bid item prices for "Structural Plate Pipe, (Material), (Thickness), (Diameter)", for "Structural Plate Pipe Arch, (Material), (Thickness), (Span)", for "Structural Plate Arch, (Material), (Thickness), (Span)", and for "Underpass, (Design), (Thickness), (Span)" of the design, type, gage or thickness, and size specified shall include all costs for the work required to furnish, haul, and assemble in place the completed structure including excavation, stockpiling, disposal, backfilling.

5. **Other payment information**.

Payment for the class of concrete shall be as specified in Section 6-02.5.

Payment for steel reinforcing bar shall be as specified in Section 6-02.5.

Payment for structure excavation shall be as specified in Section 2-09.5.

Payment for imported "Mineral Aggregate, (Type)" backfill shall be per Section 4-01.5.

Payment for trench safety systems will be in accordance with section 7-17.5.

SECTION 7-04 RESERVED

SECTION 7-05 MANHOLES, CATCH BASINS, AND INLETS

7-05.1 DESCRIPTION

Section 7-05 describes work consisting of constructing manholes, catch basins, inlets, and the rebuilding or rechanneling of existing manholes in accordance with *the Contract* at locations shown on the Drawings. This work shall also include excavation, *and* backfilling and compaction as specified in Section 7-17.

Work in trench excavations over 4 feet deep shall comply with Section 7-17.3(1)A7a, Trench Safety Systems.

7-05.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Manholes, Catch Basins, Inlets, Appurtenance, and Related	9-12

Manholes, catch basins and inlets shall be constructed of pre-cast components in accordance with the following Standard Plan nos.:

Drainage Structure	**Standard Plan nos.**
Manholes	200a through 207
Catch Basins	240 through 243b
Inlets	250 and 252

Deviations from Standard Plans, other than Material(s) substitutions allowed in Section 9-12, shall be subject to a Shop Drawing submitted by Contractor and approved by the Engineer. Substitution(s) in Materials indicated on the Standard Plans and allowed in Section 9-12 shall comply with the requirements in Section 1-06.1. Concrete masonry units or concrete (masonry) rings may be used for adjustment of the casting to final Street grade.

Joints between manhole components shall be rubber gasket.

The concrete mix for manhole channel shall be Class 6 (3/4) *(see Section 5-05.3)*.

Concrete for manhole, catch basin, and inlet structures shall be Class AX (see Section 6-02.3).

Precast manhole components shall conform to ASTM C 478 except as modified in Section 7-05.

7-05.3 CONSTRUCTION REQUIREMENTS

7-05.3(1) MANHOLE

7-05.3(1)A FOUNDATION PREPARATION

7-05.3(1)A1 DEWATERING

Dewatering of manhole and catch basin excavations shall comply with the applicable Sections of Section 7-17.3(1)A.

7-05.3(1)A2 FOUNDATION PREPARATION

Adequate foundation support shall be obtained by compacting the existing Subgrade to a 95% for a 12 inch depth in accordance with Section 2-03.3(14)E. Where unsuitable foundation conditions exist**,** removal of unsuitable Material and replacement with compacted suitable or imported Material will be required.

7-05.3(1)B BEDDING

7-05.3(1)B1 BEDDING AND FOUNDATION SUPPORT FOR PRECAST BASE SECTION

Manholes and catch basins constructed with precast base sections shall be placed to grade upon a 6-inch minimum thickness of Mineral Aggregate Type 9 per Section 9-03 mixed with 4 sacks of Portland cement per cubic yard of Mineral Aggregate, with sufficient water added to form a stabilized foundation. The mixed Material shall be placed across the area of the excavation for the base to a minimum distance beyond the face of the manhole as indicated on the Standard Plans and shall be graded to provide uniform bearing support with the precast base section.

7-05.3(1)B2 BEDDING AND FOUNDATION SUPPORT FOR CAST-IN-PLACE BASE SECTION

All cast-in-place bases for manholes and catch basins shall be poured to grade upon a properly prepared foundation as indicated in the Standard Plans. Imported Mineral Aggregate Type 2, when required in the Contract, shall be placed and compacted to the same limits specified in Section 7-05.3(1)B1. The concrete base shall meet the requirements indicated in the Standard Plans.

7-05.3(1)C DIMENSIONS

Manhole types indicated on the Drawings shall conform in all respects to dimensions, and range of dimensions when applicable, as shown on the Standard Plans for each type manhole specified.

7-05.3(1)D REINFORCED CONCRETE

7-05.3(1)D1 *CONCRETE* MIXTURE

Concrete shall meet the requirements of Section 9-12.1(1).

7-05.3(1)D2 CURING

Upon completion of *concrete* casting, the precast components shall be protected and cured in a moist atmosphere maintained by injection of steam for the requisite length of time and at the required temperature to develop the compressive strength required for manhole components.

Precast components may also be water-cured by any approved *method that* keeps the components continuously moist during the curing period. Cast-in-place components shall be moist cured for a period not less than 7 Days, except that Type III Portland cement concrete shall be cured for not less than 3 Days.

A pigmented membrane curing compound may be applied in lieu of moist curing with prior approval of the Engineer.

7-05.3(1)E BASE

7-05.3(1)E1 GENERAL

Base sections shall conform to the requirements for precast manhole sections in Section 7-05.3(1)F, except that the reinforced base slab shall be made an integral part of the section, and openings for pipe shall be provided to meet job requirements as indicated on the Drawings. The base slab thickness shall be not less than that indicated on the Standard Plans, and on Type 200 and Type 201 manhole the base slab shall be cast monolithically with the wall section or otherwise constructed in such manner as to achieve a completely watertight structure.

Reinforcement of the base slab shall be in accordance with the Standard Plans. The steel shall be placed 1-1/2 inches from the top, and shall extend into the wall of the manhole section and be tied to the longitudinal steel when called for in the Standard Plans. The walls of the base section shall be reinforced in accordance with ASTM C 478. Openings to receive pipe shall be circular, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. Resilient connectors conforming to ASTM C 923 may be used at the Contractor's option.

7-05.3(1)E2 PRECAST BASE

The base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment and ensuring that all entering pipes can be inserted on proper grade.

All lift holes shall be thoroughly wetted and then completely filled with mortar and smoothed both inside and out to ensure watertightness. All joints between precast sections shall be rubber-gasketed joints.

Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimensions, and watertight.

In precast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush with the inside wall surface after the manhole has been completed. No sharp cutoff protrusion will be permitted. If concrete spalling occurs as a result of the loop removal, the spalled area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

All precast manhole bases and catch basins shall be manufactured with thin-walled concrete blockouts for pipe connections conforming to pipe size(s) and alignment(s) shown on the Drawings. Blockouts shall contain no reinforcing steel. Removal of reinforcing steel or of any concrete beyond the blockouts shall not be allowed. Openings for pipe connections in manhole types 200, 201, and 202 shall be no larger than the outside diameter of pipe plus 4 inches. Openings for pipe connections in manhole types 203, 204, 205, and 206 shall be no larger than the outside diameter of pipe plus the manhole wall thickness.

7-05.3(1)E3 CAST-IN-PLACE BASE

The first precast section shall be placed on the cast-in-place bottom slab and shall be carefully adjusted to true grade and alignment. The bottom slab shall be constructed in accordance with the modified Standard Plans. *The Contractor prior to placing the bottom slab of the manhole shall inspect the existing pipe which the manhole is to be built around.* If the existing line is in bad condition, the Contractor shall immediately notify the Engineer to replace the pipe. The bottom slab shall not be placed prior to the replacement of the damaged pipe.

The first manhole section shall be uniformly supported by the base concrete, and shall not bear directly on any pipe.

All lift holes and openings around pipes on precast components and cast-in-place bases or Structures shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

Precast sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimension, and watertight.

7-05.3(1)F PRECAST WALL SECTIONS

Reinforcement for standard (*riser*) sections shall consist of a single cage of steel, placed at the approximate center of the wall section. The cage shall be welded at every circumferential wire, or lapped 40 diameters and tied. The welded splice shall develop a tensile strength of 50,000 psi.

Joints between sections shall be tongue and groove, and shall provide 1/2 inch nominal annular space and a minimum of 1-1/4 inches lap.

No more than two lift holes shall be cast into each section. Holes shall be so located as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Steps shall be installed in each section so that sections placed together in any combination provide a continuous vertical ladder with rungs equally spaced at 12 inches. The lowest rung shall be not more than 16 inches above the shelf.

Steps shall project uniformly from the inside wall of the manhole per Standard Plan no. 232 and shall be cast or firmly grouted in place to ensure complete watertightness. *Where it is intended that manholes be installed without fixed steps, the Contract will so specify.*

7-05.3(1)G PRECAST CONES

Standard precast cones shall provide reduction in diameter within a range of height from not less than 18 inches to a maximum 24 inches (see the Standard Plans for cone dimensions). Jointing of cone section to the riser sections shall be similar to jointing between riser sections, but the top surface of the cone section shall be flat and at least 5 inches wide, radially, to receive adjustment bricks. Wall thickness shall be 4 inches minimum, and reinforcing shall conform to the requirements specified for standard sections of the larger diameter. Steps shall be provided as specified for standard precast sections, and an additional step *or handhold* shall be provided in all concrete cones *on the side* opposite the ladder steps at about midheight *of cone section as shown on Standard Plan no. 208.*

No more than two lift holes shall be cast into each cone, and they shall be located so they do not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Handholds (steps) installed in leveling bricks or flat slab shall be modified to allow a minimum clear opening of 21 inches measured at the shortest dimension, but the handhold shall be not less than 3 inches from the inside face of the wall.

7-05.3(1)H FLAT SLAB COVERS

Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)I FLAT SLAB REDUCTION SECTIONS

Reductions to 24-inch and 48-inch openings can be made by means of a flat slab reducing section as shown on *Standard Plan nos. 200 through 206, "b" series only*. Standard flat slab covers shall be a minimum of 8 inches thick and shall conform to the outer dimension of the standard sections upon which they are to be placed. Details of opening location and reinforcing shall be as shown on the Standard Plans.

7-05.3(1)J T-TOP PIPE MANHOLES

T-Top pipe manholes shall conform to the Drawings and shall be provided with foundation and bedding.

7-05.3(1)K JOINTS

Joints between precast manhole components shall be rubber gasketed in a manner similar to pipe joints conforming to ASTM C 443. *Shop Drawings of joint details in Standard Plan nos. 200b and 201b, and of end details in Standard Plan nos. 202b, 203b, 204b, 205b, and 206b shall be submitted to the Engineer for approval at least 5 Working Days before manufacture*. Completed joints shall show no visible leakage and shall conform to the dimensions of ASTM C 478.

7-05.3(1)L SHOP FABRICATED CORRUGATED METAL MANHOLES

Shop fabricated corrugated metal manholes, shall be constructed in accordance with the Drawings. The Contractor shall submit to the Engineer at least 10 Working Days in advance of ordering, Shop Drawings of the corrugated metal manhole. The corrugated metal manhole shall conform to all applicable provisions of these Standard Specifications.

7-05.3(1)M MANHOLE CHANNELS

All manholes shall be channeled unless otherwise *specified* in *Contract*.

Manhole channels shall conform to the curvature of the connecting pipes. Manhole channel slopes shall be made to conform accurately to the Sewer grade and shall be brought together smoothly with well rounded junctions. Where pipe connections have differing grades or differing invert elevations or differing inside diameters, a smooth transition in channel grade(s) or side(s) is required. Channel sides for each pipe shall be carried up vertically from the I.D. at the springline to the crown elevation of the pipe. The concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

7-05.3(1)N MANHOLE PIPE CONNECTIONS

All pipes, except CMP and PVC pipe, entering or leaving the manhole shall be provided with flexible joints within 1/2 of a *pipe inside diameter* or 12 inches, whichever is greater, from the outside face of the manhole structure and shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the Sewer trench. *Openings surrounding pipes entering the manhole shall be completely filled with either a non-shrink cement sand grout and shall be finished flush with the remaining manhole concrete wall surfaces to ensure watertightness*. PVC pipe connecting to manhole shall be provided with a manhole adapter complete with gasket and approved by the Engineer. No pipe joint in PVC pipe shall be placed within 10 feet of the outside face of the manhole.

7-05.3(1)O BACKFILL

Backfill around drainage Structures, such as manholes, catch basins, inlets, and related Structures, shall consist of suitable Material and shall be placed as a backfill in accordance with Section 7-17.3(3).

7-05.3(1)P MANHOLE GRADE ADJUSTMENT

The Contractor shall be responsible for selecting the appropriate precast concrete manhole components, allowing for a maximum height of 2 foot 2 inch from the top of the cone section or top slab to the finished surface grade for installation of the manhole frame and cover including 8 inches minimum for leveling or adjustment brick, or concrete collar. The surface grade for frame and cover on unimproved roadways shall match the adjacent existing roadway surface. On Projects calling for regrading and pavement improvements, the grade sheet furnished by the Engineer will show the approximate top grade for manhole within plus or minus 0.2 feet. The final grade will be set by the Engineer.

Final elevation and slope of the frame and cover shall conform to the restored and adjacent *Street* surface. No warping of grades in lieu of manhole frame adjustment will be allowed. All joints in the brick or ring adjustment shall be filled with mortar, and the casting shall be seated in mortar placed on the top brick course. A 3/8-inch thick mortar lining shall be installed inside and outside the adjustment section to provide a smooth, watertight finish.

7-05.3(1)Q LADDER, STEPS AND HANDHOLDS

The Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the single Material of choice for step, handhold, and ladder from the Section 9-12.2 Materials available, and shall consistently use this single chosen Material in any drainage Structure. Should the Contractor request a different Material between or among different drainage Structures, then the submittal shall be clear in identifying which Material is for which drainage Structure.

Base sections of precast manholes more than 3 feet in height shall be provided with a ladder as detailed in Standard Plan no. 232. Where ladders are required, the bottom step in which the ladder is hung shall be manufactured of the same Material as the ladder.

Steps, handholds, and ladder made of copolymer polypropylene plastic manufactured by Lane International Corp., M. A. Industries, Inc., or approved equal may be substituted for galvanized steel steps, handholds, and ladder.

Where a flat slab is required in the construction of a manhole, the handholds normally required in this area may either be installed in the slab itself, or installed between the slab and leveling bricks, provided that the overall distance to the upper handhold or step, or the distance between the upper handhold or step to the top of frame, is no more than 16 inches. See Sections 7-05.3(1)F and 7-05.3(1)G for additional requirements.

7-05.3(1)R FRAME AND COVER

The casting as shown on Standard Plan no. 230 may be used without extension rings for concrete pavement, or rigid pavement base if the top of casting is level with top of finished pavement and the casting flange is below the rigid pavement. Casting with depth less than the thickness of concrete pavement shall have frame extensions (see Standard Plan no. 231) epoxied to the casting frame by the frame manufacturer to allow the top of casting to be level with the top of finished pavement, and the casting flange to be below the bottom of rigid pavement.

Where Standard Plan no. 230 casting is located within the concrete pavement or within the rigid concrete pavement base, reinforcing in the concrete pavement slab shall be installed as specified in Section 5-05.3(9). Standard Plan no. 230 casting located across, or located within 18 inch of a concrete pavement joint as measured from the casting barrel (not the flange), does not require Section 5-05.3(9) pavement reinforcing.

Total height of casting, ring extension, and leveling brick shall not exceed 26 inches.

7-05.3(1)S CONNECTIONS TO EXISTING MANHOLES

The Contractor shall verify invert elevations prior to construction. Discrepancies in invert elevations shall be immediately brought to the attention of the Engineer. The crown elevation of lateral pipes shall be the same as the crown elevation of the incoming pipe. The existing base shall be reshaped to provide a channel equivalent to that specified for a rechanneled manhole (see Section 7-05.3(1)T).

The Contractor shall excavate completely around the manhole to prevent unbalanced loading. The manhole shall be kept in operation at all times, and the necessary precautions shall be taken to prevent debris or other Material from entering the Sewer. This includes building a tight pipeline *sewage* bypass as required.

The Contractor shall core drill, line drill or wall saw an opening to match the size of pipe to be inserted. Where line drilling is the method used, the method of drilling holes shall prevent overbreakage. All openings *shall* provide a minimum of 1 inch and a maximum of 2 inches clearance around the *outside* circumference of the pipe. Upstream pipes, except PVC pipe, penetrating the walls of manholes shall be placed with the bell facing out such that the bell is placed snug against the outside wall of the manhole as the angle of penetration allows. *Pipe, except PVC pipe, leaving or entering manholes shall be provided with a flexible joint within 1/2 of a pipe inside diameter, or 12 inches, whichever is greater from the outside wall of the manhole*. After pipes have been placed in their final position, the surface area around the opening in the manhole and the surface of the pipe shall be cleaned of all dirt, dust, grease, oil and other contaminants and then roughened and wetted with water. The opening between pipe and broken out concrete shall be grouted as specified in Section 7-05.3(1)N. PVC pipe connecting to an existing manhole shall be installed according to Section 7-05.3(1)N.

7-05.3(1)T RECHANNEL EXISTING MANHOLE

Rechanneling of an existing manhole shall include all as necessary work, such as, excavating shelf and manhole bottom, filling existing channel or channels with concrete, installing the new channel or channels, constructing new pipe opening or openings, and finishing the channel(s) and shelf(ves). It shall also include the work of connecting the pipe to the manhole in accordance with Section 7-05.3(1)S. Rechanneling shall meet the requirements specified in Section 7-05.3(1)M.

7-05.3(1)U REBUILD EXISTING MANHOLE

Where noted on the Drawings, the Contractor shall rebuild the existing manhole per Standard Plan no. 208 to accommodate a new manhole frame and cover meeting the requirements of Standard Plan no. 230. Work required to rebuild an existing manhole includes excavation around the manhole; removal and salvage of the existing manhole frame and cover; removal of leveling or adjustment bricks or rings; and removal of the upper portion of the cone section to a depth yielding an opening of inside diameter as indicated on Standard Plan no. 208. The cone section shall be rebuilt; leveling bricks or rings installed; new manhole steps and handholds installed meeting the requirements of Sections 7-05.3(1)F or 7-05.3(1)G, and a new frame and cover installed in accordance with Section 7-05.3(1)R.

Excavation, backfill with suitable Material, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance with Section 2-02.3(7).

7-05.3(2) CATCH BASINS AND INLETS

7-05.3(2)A GENERAL

Construction requirements for catch basins and inlets shall follow all applicable Specifications of Section 7-05.3(1) for manholes and manhole pipe connections with the exception *that* no channeling is required. *The "joint details by Contractor" in Standard Plan no. 243a shall be submitted by the Contractor to the Engineer for approval at least 5 Working Days in advance of ordering the catch basin.*

Catch basins shall be installed as indicated on Standard Plan nos. 260a and 260b unless the Contract indicates otherwise.

Catch basin shall be installed at an elevation which provides at least 2 feet 8 inches of clearance between the outlet pipe and the bottom of the basin. Connections to the catch basin shall be made only *either* at the pre-drilled holes or *at the concrete* knock outs provided in the walls of the catch basin. In order to meet this requirement, the Contractor shall determine beforehand the approximate elevation of the proposed inflow and outflow pipes by taking into account the length of inlet connection pipe, the throw in the roadway, and any existing utilities or obstructions that may interfere with installing the inlet connection pipe. All these items have a bearing on the depth of the inlet pipe at the catch basin, and the bottom elevation of the catch basin.

Where it is necessary for the Contractor to set the catch basin deeper to accommodate the deeper incoming pipe, the additional depth of the catch basin requires additional rows of leveling *or adjustment* bricks, up to a maximum of 16 inches, or installation of a one-foot to two-foot high concrete ring section below the top slab or cone section. This added concrete ring section shall be compatible with the Standard Catch Basin Section and shall accommodate rubber gaskets at the joints.

7-05.3(2)B PIPE CONNECTIONS FOR CATCH BASINS AND INLETS

All new catch basins shall be provided with openings or *concrete* knockouts for insertion of pipe connections and with a trap for the outlet pipe. The Contractor shall furnish and install new *outlet* traps for relocated and rebuilt catch basins. When connections are to be made to existing catch basins with no available hole or knockout, or where a “knockout” of adequate

size is not provided, pipe connections shall be accomplished by core drilling, line drilling or wall sawing. All openings *shall* provide a minimum of 1 inch and a maximum of 2 inches clearance around the circumference of the pipe. Where line drilling is the method used, the method of drilling holes shall prevent overbreakage. After pipes have been placed in position, the opening between pipe and wall of catch basin or inlet shall be grouted as specified in Section 7-05.3(1)N. *See Sections 7-08.3(4) and 7-08.3(5) for additional pipe connection requirements.*

The outlet trap and the frame and grate shall be located as shown on the Standard Plans and shall be vertically aligned to allow reasonable access for removal and replacement of the outlet trap for vactor cleaning maintenance operations.

7-05.3(2)C CATCH BASIN GRADE ADJUSTMENT

Catch basin frame and cover grade adjustment shall be in accordance with Section 7-05.3(1)P.

7-05.3(2)D INLET GRADE ADJUSTMENT

The inlet frame may be either cast into a concrete collar or set flange down on a minimum of one row of concrete adjustment blocks and mortared. It shall not, in any case, be *mortared* to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to mortar the *frame* in place. Location of inlet will be staked by the Engineer. The bottom of the inlet shall be level with the invert of the outlet pipe.

7-05.3(2)E RELOCATE EXISTING CATCH BASIN OR INLET

Work required for relocation of existing catch basin or inlet shall include necessary excavation to remove without damage the existing catch basin or inlet, its frame and grate or cover and transporting and installing at the new location. Backfill *shall consist of suitable material* and compaction shall be in accordance with Section 7-17.3(3). Grade adjustment shall be in accordance with Sections 7-05.3(2)C or 7-05.3(2)D.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

Existing Type 164 inlets shall be removed and disposed of when a Project requires removal and replacement of pavement containing the Type 164 inlet.

7-05.3(2)F REBUILD EXISTING CATCH BASIN

Where noted on the Drawings, the Contractor shall rebuild existing catch basin to accommodate a new frame and grate, or cover, as designated in the Contract. Work required to rebuild catch basin includes excavation, the removal of the existing frame and grate or cover, leveling or adjustment bricks, upper portion of catch basin chamber, and installing a new cone section, leveling or adjustment bricks and new frame and grate or cover. Excavation, backfill, and compaction shall conform to the applicable portions of Section 7-17. Salvage shall be in accordance to Section 2-02.3(7). Grade adjustment shall be in accordance with Sections 7-05.3(2)C.

The Contractor shall furnish and install new outlet traps (see Section 7-05.3(2)B for outlet trap location requirements).

7-05.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Extra Depth (Type) Manhole" will be by the vertical foot for all depth in excess of 10 feet measured from the invert of the outlet pipe to the top of the casting.

Measurement for Extra Depth for the type of manholes which are built on top of and are fully supported by large diameter pipe, will be by the vertical foot for extra depth in excess of the 10 feet measured from the springline of the *"supporting"* pipe to the top of the manhole casting.

Measurement for "Extra Depth, Catch Basin" will be by the vertical foot for any 4 foot diameter riser section required over the 4 foot diameter catch basin Standard section shown in Standard Plan no. 240.

7-05.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-05 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Manhole (Type)",** per each.

The Bid item price for "Manhole (Type)" shall include all costs for the work required to furnish and install the manhole complete to finish grade, including excavation, bedding, mortar, non-shrink grout, brick, block, castings, channeling, ladder, steps, connections to pipelines, and backfill with suitable native Material for a manhole depth up to and including 10 feet.

2. "**Extra Depth, (Type) Manhole**", per vertical foot.

The *Bid item price* for "Extra Depth, (Type) Manhole" shall include all costs for the work required to construct the portion of a manhole in excess of 10 vertical feet. Payment for extra depth of the A and B types of manhole will be made under the three digit Standard Plan number as 200A, 200B, 201A, 201B, etc.

3. "**Rechannel Manhole**", per each.

The Bid item price for "Rechannel Manhole" shall include all costs for the work required to complete the manhole rechanneling work as specified in Section 7-05.3(1)T and of core drilling openings for new pipes to the manhole when performed in an existing manhole.

If connecting a new pipe to an existing manhole requires rechanneling of the manhole, the work involved in connecting such pipe to the manhole is incidental to "Rechannel Manhole", per each, and shall be performed as specified in

Section 7-05.3(1)T. *If the work involves only the cutting of an opening and connecting the pipe without rechanneling, then this work shall be considered included in the Bid item price for installation of the pipe and no other payment will be made therefore.*

4. "**Catch Basin, (Type)",** per each.

The *Bid item price* for "Catch Basin, (Type)" shall include all costs for the work required to furnish and install the catch basin including trap, excavation, backfill, adjustment brick and blocks, mortar, non-shrink grout, plaster, and castings.

5. "**Extra Depth, Catch Basin**", per vertical foot.

The Bid item price for "Extra Depth, Catch Basin" shall include all costs for the work required to construct a catch basin in excess of the standard height as shown in Standard Plan no. 240 when 4 foot diameter riser section(s) are used.

6. "**Inlet, (Type)",** per each.

The *Bid item price* for "Inlet, (Type)" shall include all costs for the work required to furnish and install the inlet including excavation, brick, block, mortar, and castings.

7. "**Rebuild (Item)",** per each.

The Bid item price for "Rebuild (Item)" shall include all costs for the work required, including the new casting, to completely rebuild the existing item to finished Street grade as specified in Sections 7-05.3(1)U or 7-05.3(2)F as applicable.

8. "**Relocate (Item)",** per each.

The Bid item price for "Relocate (Item)" shall include all costs for the work required to relocate the catch basin or inlet including furnishing and installing new outlet trap, excavation and backfill with native Material, adjustment brick and blocks, mortar, non-shrink grout, plaster and castings in accordance with Section 7-05.3(2)E.

9. **Other payment information**.

When Mineral Aggregate Type 17, or other Mineral Aggregate Type designated by the Engineer, is used as backfill, payment shall be per Section 1-09.4.

Payment for "Extra Excavation", will be per Section 7-17.5.

Foundation Material will be paid as "Mineral Aggregate, (Type)".per Section 4-01.5.

When it is determined by the Engineer that the existing foundation is unsuitable and where foundation Material is not specified in the Contract and no Bid item for "Mineral Aggregate, (Type)" of the type required by the Engineer is included in the Bid Form, payment will be made in accordance with Section 1-04.1(2).

Final adjustment of the casting for new construction of manhole, catch basin and inlet shall be considered *incidental to* and included in the *Bid item price* for the manhole, catch basin, and inlet.

Where a newly constructed manhole and casting has been completed to finished grade set by the Engineer and is later required to be adjusted to a revised grade by the Engineer, the adjustment *will be paid* in accordance with Section 1-09.4.

Payment for trench safety system will *be paid* as specified in Section 7-17.5.

SECTION 7-06 PIPE ANCHORS

7-06.1 DESCRIPTION

Section 7-06 describes work consisting of constructing concrete pipe anchors, prefabricated pipe anchors on tongue and groove concrete pipe and other pipes as designated and in accordance with WSDOT Standard Plan no. B-12 and as otherwise indicated in the Contract.

7-06.2 MATERIALS

Material shall meet the requirements of the applicable portion of Sections 6-02 and 6-03.

7-06.3 CONSTRUCTION REQUIREMENTS

The construction shall be in accordance with the Drawings and the applicable portions of Sections 6-02.3 and 6-03.3.

7-06.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

7-06.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-06 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "**Pipe Anchor",** per each.

The Bid item price for "Pipe Anchor" shall include all costs for the work required to furnish and install the pipe anchor.

SECTION 7-07 CLEANING EXISTING DRAINAGE STRUCTURES

7-07.1 DESCRIPTION

Section 7-07 describes work consisting of cleaning and removing all debris and obstructions from existing Culvert pipes, sanitary Sewer pipes, combined Sewer pipes, drains, inlet Structures, manholes, box Culverts, grates, trash racks, or other drainage features in conjunction with the Work within the Project Site.

7-07.2 *RESERVED*

7-07.3 CONSTRUCTION REQUIREMENTS

Existing drainage facilities connecting to new work shall be cleaned as a first order of Work to enhance drainage off and through the Project Site. *These facilities* shall be kept clean *up to the Physical Completion Date*.

All *existing* pipes and drainage Structures *connecting to new work* shall be cleaned by flushing, or by rodding, or *by such manner as may be necessary as approved by the Engineer* to provide unobstructed drainage. All catch basin sumps, manholes, inlet and outlet Structures, and debris racks shall also be freed of all dirt, rock, and debris.

7-07.4 MEASUREMENT

Work described in Section 7-07 will not be measured for payment.

7-07.5 PAYMENT

All work described in Section 7-07 shall be considered incidental to the various Bid items comprising the Work.

SECTION 7-08 MISCELLANEOUS PIPE CONNECTIONS

7-08.1 DESCRIPTION

Section 7-08 describes work consisting of excavation, foundation preparation, bedding, backfilling and compacting for the construction of miscellaneous Sewer and drain appurtenances other than those described in Sections 7-01, 7-17 and 7-18.

Work in trench excavations over 4 feet deep are subject to Trench Safety Systems, Section 7-17.3(1)A7a.

7-08.2 MATERIALS

Materials shall meet the requirements in Section 9-04 and Section 9-05.

7-08.3 CONSTRUCTION REQUIREMENTS

7-08.3(1) *EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL*

Trench excavation and backfill shall be as specified in Section 7-17.

7-08.3(2) CONNECTIONS TO EXISTING SANITARY SEWERS

When making a connection to an existing sanitary Sewer line or manhole, the Contractor shall excavate and expose the existing facility where shown on the Drawings. In the event there is no existing tee or wye, refer to Section 7-17.3(2)C3 “CUT-IN TEE ON EXISTING PIPE”. See Section 7-05.3(1)S for connections to existing manholes.

7-08.3(3) PIPE INSTALLING, JOINTING, AND TESTING

Pipe installing, bedding, jointing, backfilling, and pipe connections shall conform to the applicable requirements of Section 7-17. Testing for acceptance as provided in Section 7-17.3(4) will not be required.

7-08.3(4) CATCH BASIN CONNECTIONS

Catch basin connections are pipe lines connecting outlets of catch basins to a Storm Drain or other facility. *Both the alignment and the slope shall be straight with the exception of maintaining clearances in accordance with Section 1-07.17(2). Ninety degree (90°) bends will not be allowed*.

No connection shall be made to the catch basin outlet pipe until the excavation around the catch basin has been backfilled and compacted to an elevation which provides support for pipe bedding and the connection pipe. Bedding for catch basin connection pipe shall be Class B bedding.

Connection pipe may be deflected at the joint to avoid obstacles to within the allowable angular deflection recommended by the pipe manufacturer. Such deflection shall be water tight and allow rodding the pipe in a relatively easy manner. Where pipe joints must be deflected, the Contractor shall submit the manufacturer's pipe joint deflection criteria to the Engineer for approval. Under no circumstances will deflection or change of direction be allowed by cutting or trimming the end of the pipe on a bias or an angle. All pipe ends shall be normal angle.

The Contractor shall furnish and install a new *outlet* trap to the new outlet of the existing catch basin.

See Section 7-05.3(2)B for outlet trap location and catch basin pipe connection requirements.

7-08.3(5) INLET CONNECTIONS

Inlet connections are pipe connections from drainage inlets to catch basins or other approved outlets. Inlet connections shall be installed upgrade from catch basin openings or other originations in straight alignment and shall be on a uniform slope. Where a straight alignment or a uniform slope is not feasible and curves are necessary, the altered alignment shall be made by deflecting each pipe into a smooth curve. *Bends with angles greater than 22.5 degrees shall not be used.* Each pipe joint deflection shall not exceed that necessary to maintain a watertight connection as recommended by the pipe manufacturer. *The Contractor shall submit the pipe manufacturer's pipe joint deflection criteria.*

Pipe connections to a catch basin or other approved outlet shall not be made until the compaction requirements as specified in Section 7-08.3(4) have been met and the *work* has been approved by the Engineer. Bedding for inlet connection pipe shall be Class B bedding.

See Section 7-05.3(2)B for inlet pipe connection requirements.

7-08.3(6) DROP CONNECTIONS

Drop connection, used in conjunction with different types of manholes to allow for abrupt drop in elevation of the Sewer line, shall be constructed of ductile iron pipe in accordance with Standard Plan no. 233. Drop connections shall be constructed at locations indicated on the Drawings and shall match the given design invert elevations.

7-08.3(7) VERTICAL CONNECTION

Vertical connections shall be constructed in accordance with Standard Plan no. 234, unless the Contract specifies otherwise.

7-08.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" will be by the linear foot of pipe installed between the tee or wye in the receiving *Sewer* and the inside face of the catch basin.

Measurement for "Pipe, Inlet Connection (Material) (Class), (Size)" will be by the linear foot of pipe installed between the inside face of the inlet, and the inside face of the catch basin.

Measurement for "Drop Connection (Size)" will be by the vertical foot from the invert at the bend connection to the manhole to the invert at the upstream end of the tee as shown on Standard Plan no. 233.

Measurement for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" when the pipe is an outlet pipe from a flow control Structure will be measured from the inside wall of the flow control Structure (see Section 7-16.4).

7-08.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-08 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Pipe, Catch Basin Connection, (Material), (Class), (Size)",** per linear foot.
2. **"Pipe, Inlet Connection, (Material), (Class), (Size)",** per linear foot.

The *Bid item prices* for "Pipe, Catch Basin Connection, (Material), (Class), (Size)" and for "Pipe, Inlet Connection, (Material), (Class), (Size)" shall include all costs for the work required to furnish and install the pipe, including connections to catch basins or inlets, excavation, backfill, and compaction.

3. "**Drop Connection, (Size)",** per vertical foot.

The *Bid item price* for "Drop Connection, (Size)" shall include all costs for the work required to furnish and install the complete drop connection, including the concrete footing, ductile iron spool and fittings at the drop connection and the ductile iron pipe that spans between the flexible coupling and the tee of the drop connection.

4. **Other payment information**.

The cost for furnishing and installing new outlet trap when installing catch basin connection pipe to existing catch basin shall be included in the Bid item price for "Pipe, Catch Basin Connection, (Material), (Class), (Size)".

Payment for bedding will be in accordance with Section 7-17.5.

Payment for trench safety system will be as specified in Section 7-17.5.

SECTION 7-09 PIPE AND FITTINGS FOR WATER MAINS

7-09.1 DESCRIPTION

Section 7-09 describes work included under Sections 7-09 through 7-15 consisting of the construction of water distribution and transmission pipelines and appurtenances for both temporary and permanent installations.

7-09.2 MATERIALS

Materials shall meet the requirements of Section 9-30.

Polyvinyl chloride, polyethylene, polybutylene, and asbestos cement as pipe material, and the use of elastomers (such as those used in jointing gaskets and packing glands), shall not be used as or incorporated in Water Main to convey potable water.

The Contractor shall only install new and unused Materials suitable and approved for potable water supply.

It is not intended that Materials listed herein for potable Water Mains, fittings, and appurtenances are to be necessarily considered equally suitable or generally interchangeable for all applications. It is intended that "or equal" or "or approved equal" or any Material substitution will not be allowed unless the Contract so specifies (see Section 1-06.1). Those Materials suitable for the Project will be specified in the Contract.

The pipe manufacturer shall test all pipe and fittings as required by these Standard Specifications and by the applicable recognized standards of national organizations referenced (see Section 1-06.2). The pipe manufacturer shall submit to the Engineer two copies of all test results including a Manufacturer's Certificate of Compliance that Material to be delivered to, and intended for incorporating in, the Project is represented by the samples tested and that such delivered Materials meet or exceed the specified requirements. No pipe shall be delivered until test results and Manufacturer's Certificate(s) of Compliance are approved by the Engineer.

The Engineer shall have free access to all testing and records pertaining to Material to be delivered to the Project Site. The Engineer may elect to be present at any or all Material testing operations.

7-09.3 CONSTRUCTION REQUIREMENTS

The Contractor shall not operate any valve on an existing Water Main.

Trench excavation, bedding, and backfill for Water Mains is described in Section 7-10.

Pipe installation for Water Mains and fittings is described in Section 7-11.

Valves for Water Mains is described in Section 7-12.

Hydrants are described in Section 7-14.

Water service connections are described in Section 7-15.

7-09.4 RESERVED

7-09.5 RESERVED

SECTION 7-10 TRENCH EXCAVATION, BEDDING AND BACKFILL FOR WATER MAINS

7-10.1 DESCRIPTION

Section 7-10 describes work consisting of excavating, bedding, and backfilling for Water Mains and the construction of distribution *and transmission Water* Mains and appurtenances for both temporary and permanent installation.

Water Mains shall be constructed at the locations shown on the Drawings.

Where rough grading is required at the beginning of Work, such grading, including excavation and embankment construction, shall conform to the requirements of Section 2-03. Rough grading shall be completed before excavating for the Water Main trench.

Borrow and disposal sites shall conform to the requirements of Section 2-01.

7-10.2 MATERIALS

Materials specified as “Mineral Aggregate, (Type)” shall be in accordance with Section 9-03.

7-10.3 CONSTRUCTION REQUIREMENTS

7-10.3(1) GENERAL

See Section 7-17.3(1)A7a regarding trench excavation safety requirements. See Section 7-10.3(7) *for additional trench excavation* requirements when the Work involves construction of potable Water Mains *and related* Structures *and appurtenances.*

See Sections 1-07.23 and 1-10 regarding construction operations and *Traffic*.

Clear access shall be provided and maintained to fire hydrants, water valves, water meters, water vaults, and related water Structures.

Clearance shall be left to allow storm water to flow freely in gutters, other conduits, and natural watercourses.

Water distribution main, water transmission main, water services, and fire hydrant and connection pipe shall be installed at least five (5) feet clear of any tree measured edge to edge.

7-10.3(2) UNGRADED STREETS

On ungraded *Street*s, when grading is not called for in the Contract, the depth of trench excavation shall be as indicated on the Drawings and as staked by the Engineer.

Where the Drawings show pipe is to be installed above existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the Drawings, and the Water Main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 2-03.3(14)D.

7-10.3(3) CLEARING AND GRUBBING IN UNGRADED STREETS

See Section 2-01.

7-10.3(4) REMOVAL OF EXISTING STREET IMPROVEMENTS

See Section 2-02.

7-10.3(5) GRADE AND ALIGNMENT

7-10.3(5)A GENERAL

Trenches for pipe shall be opened in accordance with the lines and grades indicated on the Drawings, and to a depth that maintains the minimum required depth of cover unless indicated otherwise *in the Contract* (see Section 7-10.3(5)C).

On improved Street*s, the grade and alignment shall be taken from established points set by the Engineer.*

7-10.3(5)B VERIFICATION OF LOCATION

After marking underground facilities (see Sections 1-07.17(1) and 7-10.3(6)) and prior to any pavement cutting or removal or excavation for pipe installation, the Contractor shall verify, in the presence of the Engineer, the locations of existing Water Mains. The Contractor shall arrange to establish their depths at points where connections are to be made. After excavation, the Contractor shall verify the dimensions, type, and condition of the exposed Water Main. Should a condition be discovered which materially differs from indicated in the Contract, the Contractor shall immediately notify the Engineer. When

necessary, the profile shall be adjusted as directed by the Engineer so that abrupt changes in grade and alignment of Water Main and connection are prevented.

7-10.3(5)C MINIMUM DEPTH OF COVER

The depth of trenching for distribution Water Mains shall give a minimum depth of cover as indicated on Standard Plan no. 030. The depth of trenching for transmission Water Main shall give the minimum depth of cover as indicated in the Contract. Where profile of Water Main and ground surface is shown on the Drawings, the Water Main shall be installed to the elevation shown on the Drawings, regardless of depth of cover for distribution Water Main indicated on Standard Plan no. 030. Deeper excavation may be required due to localized breaks in grade or due to installing the new distribution Water Main under existing Culverts or other underground facilities where necessary. Excavation shall be to such depth that the cover over the valve operating nut shall be a minimum 1 foot.

7-10.3(6) *EXISTING UTILITIES AND TEMPORARY SERVICE CONNECTION*

See Section 1-07.17 for utilities and similar facilities and for Water Main clearance requirements.

When utility services occupy the same space as the new Water Main, the Contractor shall do all necessary excavation to fully expose such services. The Contractor shall protect said services and work around them during excavating and pipe installation operations. *The Contractor shall be responsible for all damage to the services. When existing services are damaged due to Contractor operations, the Contractor shall immediately notify the Engineer and arrange for timely repair or replacement. In the event of conflict with other underground facilities, the Contractor shall immediately notify the Engineer.* Mainline Sewers and storm drains shall not be damaged, removed or relocated. Water Main pipe shall be installed to clear these utilities (see Section 1-07.17).

Existing Water Mains and fittings encountered during trench excavation and indicated on the Drawings to be removed (or if removal is required by the Engineer) shall be removed and disposed of by the Contractor. See Section 2-02.

All ends of abandoned Water Main shall be plugged in accordance with Section 2-02.3(5). Pipe 12 inch and larger shall be abandoned and filled in accordance with Section 2-02.3(5).

It is anticipated that the Contractor will encounter water service laterals and appurtenances (water service lines running between the SPU Water Operations union and private residences) during work operations. Records of these underground facilities are not maintained by the City and therefore do not appear on the Drawings and will not be field located by SPU Water Operations. It shall be the Contractor's responsibility to ascertain the location of and protect these service laterals and appurtenances from damage.

When it is necessary to provide temporary water supply connections due to conflict between existing privately owned water service laterals and appurtenances and with the new Water Main, it shall be the responsibility of the Contractor to provide temporary services. Permanent replacement of temporary water services with new water services shall be as directed by the Engineer, and require inspection and approval by SPU Water Customer Service. The Contractor shall give a minimum 2 Working Days advance notice by contacting 206-684-5800.

Should the Contractor damage or disrupt private water services or appurtenances, the Contractor shall immediately notify the Engineer of any such damage or disruption, shall begin repairs immediately as directed by the Engineer, and shall work continuously until the condition is accepted.

7-10.3(7) TRENCH EXCAVATION

7-10.3(7)A GENERAL

Sidewalk, pavement, appurtenant Structure, adjacent improvement and underground installation adjacent to and beyond the trench shall not be undermined or disturbed.

The Contractor shall perform excavation to the depth, line, and grade indicated on the Drawings. All excavations shall be made by open cut methods and shall include excavation for pipe bedding as applicable (see Standard Plan no. 350).

The length of trench excavation in advance of pipe installation operations shall be kept to a minimum, and in no case shall it exceed 500 feet for transmission pipeline, and 200 feet for distribution Water Main.

The maximum trench width in the Right of Way shall not exceed the neatline trench width as shown on Standard Plan no. 350.

Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 350 by sloping or benching. However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting additional suitable backfill, outside of Standard Plan no. 350 neatline trench limits shall be at the sole expense of the Contractor.

When Water Main invert or other elevations are indicated on the Drawings, the Contractor shall excavate to that depth plus any additional excavation as necessary to accommodate the Contract specified class of bedding. When no invert or other elevation is indicated in the Contract, the Contractor shall excavate to a depth, including additional excavation as necessary for the class of bedding when specified in the Contract, to provide the minimum cover as indicated in Standard Plan no. 030. When Water Main elevations are specified in the Contract, excavation below that depth shall be backfilled with suitable native material and shall be compacted to 90% as specified in Section 2-03.3(14)E at the Contractor's sole expense. The Contractor shall provide overexcavation for bells such that pipe barrels and bells along the Water Main are uniformly supported full length.

Grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. *All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel,*

and provision shall be made for merging Traffic where necessary. Clear access shall be provided to all fire hydrants, water valves, and meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements. Suitable excavated material for reuse as backfill shall be *stockpiled* in an *acceptable* manner and shall be protected from becoming unsuitable. Unsuitable material, or suitable material in excess of Project needs, shall be disposed of by the Contractor (*see Section 2-01.2).*

Excavation for valve chambers and other *Water Main* Structures shall be sufficient to provide a minimum of 12 inches between their exterior surfaces and the sides of the excavation.

Prior to installation of bedding, when required in the Contract, and installation of pipe, the trench bottom shall be brought to grade as indicated for the type of bedding specified and if disturbed, compacted to 90% as specified in Section 2-03.3(14)E to provide a foundation capable of supporting the pipe full length in its proper position.

All ledgerock, boulders, stones, and any object larger than 3 inch in any dimension shall be removed within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

The Contractor shall remove any protective system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate the material as specified.

7-10.3(7)B EXTRA EXCAVATION

The requirements of Section 7-17.3(1)A2 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)C DEWATERING

In addition to the requirements of Section 7-17.3(1)A3, during the installation of Water Main, jointing, coating, cathodic and electrolysis protection, and the placement of bedding and trench backfill, excavations shall be kept free of water. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

At all times, all non-potable water and any other debris shall be prevented from entering Water Main. At the end of each day's work on any portion of Water Main, the Contractor shall provide a temporary seal ensuring nothing can enter the Water main or any new construction for the Water Main.

Also see Section 7-11.3(1) for additional requirements.

7-10.3(7)D UNEXPECTED OBJECTS

The requirements of Section 7-17.3(1)A4 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)E TRENCH EXCAVATION IN SOLID ROCK

See Section 7-17.3(1)A5. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)F SURPLUS MATERIAL

The requirements of Section 7-17.3(1)A6 shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G PROTECTIVE SYSTEMS

7-10.3(7)G1 TRENCH SAFETY SYSTEMS

The Contractor shall comply with the requirements of Section 7-17.3(1)A7a. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(7)G2 SUPPORT SYSTEM

The requirements of Section 7-17.3(1)A7b shall apply. All references to Standard Plan nos. 284 and 285 shall mean Standard Plan no. 350.

7-10.3(8) MATERIAL FROM TRENCH EXCAVATION

7-10.3(8)A REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL

See Sections 7-10.3(7)B and 7-10.3(7)F.

7-10.3(8)B SURPLUS MATERIALS

See Section 7-10.3(7)F.

7-10.3(9) BEDDING THE PIPE

7-10.3(9)A RIGID PIPE

7-10.3(9)A1 GENERAL

All distribution Water Main shall have either Class D bedding, or Class B bedding with either of Mineral Aggregates Type 6 or Type 7. All transmission Water Main shall have Class B bedding with Mineral Aggregate Type 9. See Standard Plan no. 350. Allowance for excavation to accommodate pipe bells and any fittings shall be made to provide uniform support along the pipe barrel.

Care shall be taken to prevent any damage to the pipe, to any protective coating, and to any electrolysis monitoring system.

7-10.3(9)A2 *BEDDING FOR POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE TAPE COATING, THERMOPLASTIC POWDER COATED, OR SPECIAL COATED PIPE*

Class B bedding Material for specially protected or coated pipe shall be Mineral Aggregate either Type 6 or Type 7 in accordance with Section 9-03. Class B bedding consisting of Mineral Aggregate Type 6 or *Type* 7 shall be compacted by tamping.

Bedding of specially protected pipe shall be conducted at all times in such manner as to prevent damage to the protective coating or wrap.

Placing of Class B bedding around wrapped or coated *or specially protected* pipe shall be done in a manner acceptable to the Engineer. Any damage to the special *protection or* coating or wrap shall be repaired by the Contractor at the Contractor's *sole* expense in a manner acceptable to the Engineer.

7-10.3(9)B FLEXIBLE PIPE

7-10.3(9)B1 BEDDING FOR FLEXIBLE PIPE

Bedding for flexible pipe, when flexible pipe is permitted for use, shall be Class B with Mineral Aggregate Type 22 placed in lifts as shown on Standard Plan no. 350. Care shall be used in installing flexible pipe to prevent vertical pipe deflection.

The first bedding lift thickness shall be placed, spread and compacted across the width and length of the trench bottom at the required grade to support the pipe. *Allowance shall be made for pipe bell and any other fitting.* Pipe is then installed and the next lift of bedding Material carefully placed and compacted *evenly* along both sides of the pipe up to the crown, being careful not to displace the pipe from its set line and grade. *Once the bedding is completed to the crown of the pipe, and the pipe shows no visible misalignment, the final bedding lift over the pipe shall be placed*.

7-10.3(10) BACKFILLING TRENCHES

Prior to backfilling, all form lumber and debris shall be removed from the trench. *The protective system used by the Contractor shall be systematically removed to allow for acceptable backfilling. Where Class D bedding is required, backfill up to 6 inches over the top and both sides of the pipe shall be evenly and carefully placed, but not until all material, such as rock not capable of passing a 3 inch sieve or similar objectionable material, capable of damaging the pipe or its coating or its electrolysis monitoring system have been removed from the backfill Material.*

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. *The Contractor shall backfill to a uniform depth of 1 foot above ductile iron pipe before starting compaction, and to a uniform depth of 2 feet above concrete pipe before starting compaction.*

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of *Traffic* as may be necessary, and provide for the safety of property and persons.

The Contractor shall use suitable native excavated material for trench backfill unless notified by the Engineer that the native material is unsuitable. The Engineer will examine excavated native material at the time of excavation to determine its suitability for use as backfill. Native material will be considered suitable for trench backfill if it meets the requirements set forth in Section 2-03.3(14).

See Section 7-10.3(8)A for unsuitable material and replacement Material requirements.

The Contractor shall protect suitable excavated material from becoming contaminated or excessively moist.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation *as shown on the Drawings*, and shall be leveled to provide for a uniform thickness of the *selected* Material. Compaction is required, and it shall be performed prior to placing the *selected* Material.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill. Native Material will be considered suitable for trench backfill if it is:

1. *Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;*
2. *Within reasonable tolerance of optimum moisture content; and*
3. *Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.*

Unsuitable backfill Material shall be removed from the site, disposed of per Section 2-01.2, and replaced with Mineral Aggregate Type 17 or such other imported Material as designated by the Engineer.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. See Section 7-10.3(7)A for length of trench limitations. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until new cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of cover has been placed upon the pipe.

7-10.3(11) COMPACTION OF BACKFILL

The Contractor shall place the initial lift of *loose* backfill to a uniform depth of 2 feet above the crown of concrete pipe and to a uniform depth of 1 foot above the crown of ductile iron pipe before starting compaction. Trench backfill shall continue in uniform lifts not exceeding 1 foot loose thickness and be compacted by impact type mechanical tampers approved by the Engineer. Water settling will not be permitted. Degree of compaction shall meet Section 2-03.3(14)E requirements as follows:

1. Improved areas such as *Street* and sidewalk areas, compaction shall be 95% of maximum dry density.
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

The procedure and equipment to be used for backfill compaction shall be demonstrated on a test section of Water Main backfill at a location designated by the Engineer. The Contractor shall excavate test pits as directed by the Engineer for the purpose of testing the backfill compaction. The Contractor shall make these arrangements prior to backfilling.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using an improved technique, heavier compaction equipment or more passes. This process shall be repeated until the Contractor has established a procedure that provides the required *degree of compaction*. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the *Water Main* under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction is not being obtained because of changes in soil types or for any other reason, the Contractor will be required to reestablish the compaction procedure. In no case will excavation and pipe installation operations be allowed to proceed until the specified compaction is attained.

7-10.4 MEASUREMENT

Bid items of Work completed pursuant to the Contract will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs herein this Section.

Measurement for "Solid Rock Excavation" will be in accordance with Section 2-03.4.

Measurement for "Mineral Aggregate, (Type)" will be in accordance with Section 4-01.4.

Measurement for "Extra Excavation" will be by the cubic yard of in-place material actually removed beyond the neatlines indicated on Standard Plan no. 350.

Measurement for "Bedding, (Class), (Size) Pipe" for Water Main will be in accordance with Section 7-17.4.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot" will be in accordance with Section 7-17.4.

7-10.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-10 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

Imported Material when ordered in lieu of native backfill material by the Engineer will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

Payment for "Extra Excavation" and for "Bedding, (Class), (Size) Pipe" shall be in accordance with Section 7-17.5.

Payment for "Solid Rock Excavation" shall be in accordance with Section 2-03.5.

Foundation Material, when required in the Contract, will be paid for as "Mineral Aggregate, (Type)" in accordance with Section 4-01.5.

If no Bid item is in the Bid Form for Mineral Aggregate of the Type designated by the Engineer, or for "Solid Rock Excavation" or for "Extra Excavation", the Contractor shall perform the work as directed by the Engineer, and payment will be made in accordance with Section 1-04.1(2).

No separate payment will be made for excavating the trench, placing and compacting the native backfill material, hauling and placing excess suitable native material elsewhere on the Project, or hauling and disposing of excess materials offsite whether suitable or unsuitable. These costs shall be considered as being included in the *Bid item prices* for each class, size, and type of pipe in accordance with Section 7-11.5.

Payment for "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot" will be in accordance with Section 7-17.5.

Where unexpected objects, such as stumps, railroad ties, etc. are encountered in the trench excavation, and such unexpected objects cause the Contractor delays or require extra work or Equipment for its removal, payment will be in accordance with Section 1-09.4. *When the presence of these objects is indicated in the Contract, and is not included as a Bid item in the Bid Form, the removal of these objects shall be considered included in the Bid item prices of the applicable Bid items and no separate or additional payment will be made.*

No separate payment will be made for furnishing and installing sand cushion and protection of existing utilities and services. These items shall all be included in the Bid item prices of the Water Main Bid items.

All costs for plugging ends of abandoned Water Main shall be included in the Bid item prices of the applicable Bid items.

Payment for bedding for Water main will be in accordance with Section 7-17.5.

All costs incurred by the Contractor in providing temporary water service, when deemed necessary *by the Engineer, shall be considered included in the Bid item prices for the applicable Bid items and at no additional or separate cost to the Owner.*

In the event the Contractor elects to use pipe bedding or Mineral Aggregate of any Type below the pipe to facilitate dry construction, all costs for furnishing and placing these materials shall be borne by the Contractor.

Any material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced at the Contractor's expense with Mineral Aggregate Type 17 or such other Material as the Engineer will accept.

All costs in connection with excavating test pits and from standby time during field density tests shall be considered as incidental to the backfill.

All costs for removing existing Water Mains and fittings as specified in Section 7-10.3(6) shall be considered incidental to the various Bid items comprising the Contract.

The cost for cutting and reconnecting water services by the SPU Water Operations as requested by the Contractor for his work as specified in Section 7-10.3(6) will be charged to the Contractor.

The hauling away of surplus material from the excavation to other areas of the Project or disposing of the material offsite shall be considered as incidental to the *Bid item price* of pipe installed.

SECTION 7-11 PIPE INSTALLATION FOR WATER MAINS

7-11.1 DESCRIPTION

Section 7-11 describes work consisting of installing Water Main pipe in accordance with the manufacturer's printed specifications and instructions and with the AWWA standards for installing the type of pipe proposed.

Pipe sections shall be joined in such a manner as not to damage the lining or coating. The method of pulling or jacking the pipe home *shall* allow for both vertical and horizontal movement of the pipe for protection of the gasket.

Water Main installation shall not proceed until line and grade hubs have been set and measurements for connection fittings have been made in accordance with Section 7-10.3(5).

Clearances shall be maintained between Water Mains and other utilities per Section 1-07.17.

7-11.2 MATERIAL

7-11.2(1) GENERAL

Material shall meet the requirements of Section 9-30 and Section 9-04.

Pipe and Pipe Coatings	*9-30.1*
Fittings	*9-30.2*
Valves, Valve Boxes, and Valve Chambers	*9-30.3*
Hydrants	*9-30.5*
Service Connections and Service Pipe or Tubing	*9-30.6*
Bedding, Foundation Material and Gravel	*9-30.7*
Joint Bond Cable	*9-30.10*
Thermite Weld Materials	*9-30.11*
Electrolysis Test Station	*9-30.12*
Turbine Meters	*9-30.13*
Locating Wire	*9-30.14*
Backflow Prevention Devices (BPDs)	*9-30.16*

7-11.2(2) PRE-INSTALLATION TASTE *AND ODOR* TESTING

Ductile Iron, Class 52 Water Main, per AWWA Standard C151 with cement lining per AWWA Standard C104, shall satisfactorily pass an SPU conducted Taste and Odor Rating Test, or be a product of a manufacturer pre-approved by SPU in accordance with SPU's Taste and Odor Rating Test program. Manufacturers with pre-approved Taste and Odor Rating Test programs can be obtained by contacting 206-684-7834.

Taste and odor rating tests on Water Main obtained from other than pre-approved manufacturers will be conducted as specified by the "Taste and Odor Testing of Ductile Iron Class 52 Water Main Pipe" located in the appendix of the Project Manual. The Contractor's schedule shall allow for testing not pre-approved Water Main proposed for use on the Project. A minimum of 5 Working Days will be required to conduct the Taste and Odor Rating Test on any pipe sample from each lot of 100 or fewer lengths. No pre-installation taste testing will be conducted on service connection pipe.

7-11.2(3) POST INSTALLATION TASTE *AND ODOR* RATING TESTS

The SPU Water Quality *Laboratory* may perform additional Taste *and Odor* Rating Tests on any portion of the Work prior to or after connection to existing *Water* Mains.

Failure of the system or portion of the system to pass the Taste *and Odor* Rating Test will result in the rejection of all of the new Water Main under test.

7-11.3 CONSTRUCTION REQUIREMENTS

7-11.3(1) DEWATERING OF TRENCH

In addition to the requirements of Section 7-10.3(7)C, where water is encountered in the trench, the water shall be removed during pipe installation operations and trench dewatering shall be maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water or other deleterious materials shall not be allowed to enter the pipe at any time.

7-11.3(2) HANDLING OF PIPE

7-11.3(2)A GENERAL

All types of pipe shall be handled in a manner that prevents damage to the pipe, *and* pipe lining or coating. Pipe and fittings shall be loaded and unloaded using hoists and slings in a manner to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled against other pipe. Damaged pipe will be rejected, and the Contractor shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the *Project* Site within 24 hours.

Threaded pipe ends shall be protected by couplings or other means until the pipe is installed.

The pipe and fittings shall be inspected for defects.

Ductile iron and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks. Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or installing operations, and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned, and reinstalled. A clean whisk broom shall be used for this purpose and for brushing to remove foreign matter prior to joining of pipe ends. At times when pipe installation is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure cleanliness inside the pipe.

Pipe shall be stacked in such a manner as to prevent damage to the pipe, to prevent dirt and debris from entering the pipe, and to prevent any movement of the pipe. The bottom tiers of the stack shall be kept off the ground on timbers, rails or other similar supports. Pipe on succeeding tiers shall be alternated by bell and plain end. Timbers 4-inch X 4-inch in size shall be placed between tiers and chocks shall be placed at each end to prevent movement. *Each size of pipe shall be stacked separately*.

7-11.3(2)B HANDLING SPECIAL COATED PIPE

Handling and shipping of enameled or multilayered polyethylene tape coated or thermoplastic powder coated ductile iron pipe while being transported and in the field shall be in accordance with AWWA C214, and as specified herein.

Pipe, at all times, shall be handled with equipment such as stout wide canvas slings and wide padded skids designed to prevent damage to the coating. Bare cables, chains, hooks, metal bars or narrow skids shall not be permitted to come in contact with the lining or coating. When shipped by rail, all pipe shall be carefully loaded on properly padded saddles not less than 12 inches in width. Pipe sections shall be separated so that they do not bear against each other and the whole load shall be securely fastened together and to the cars to prevent movement in transit.

In truck shipments, the pipe shall be supported in wide cradles of suitable padded timbers hollowed out on the supporting surface to fit the curvature of pipe. All chains, cables or other equipment used for fastening the load *shall* be carefully padded.

The Engineer will inspect the pipe and coating after delivery to the Project Site prior to installation by the Contractor. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling, before the pipe is lowered into the trench.

Pipe stored along the trench side shall be supported by padded wooden timbers placed under the pipe to hold the pipe off the ground, or by other acceptable means not damaging to the pipe and pipe coating.

Repair of multi-layered polyethylene tape coating shall be in accordance with AWWA C214 and Section 7-11.3(6)C. Repair of thermoplastic powder coated pipe shall be per manufacturers instructions. The Contractor shall submit at least 3 Working Days in advance the manufacturer's recommendations for thermoplastic coating repair.

7-11.3(3) CUTTING PIPE

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter. All pipe ends shall be square with the longitudinal axis of the pipe. The outside of slip joint pipes shall be beveled and smoothed so that good connections can be made without damage to the gasket. Threads shall be cleanly cut. Torch cutting of ductile iron pipe will not be allowed.

Restrained joint pipe shall be cut in accordance with the pipe manufacturer's recommendations. The Contractor shall submit at least 3 Working Days in advance, the pipe manufacturer's recommendation for cutting restrained joint pipe including a Manufacturer's Certificate of Compliance stating the cutting process does not adversely impact the pipe material or integrity of the joint.

7-11.3(4) INSTALLING PIPE ON CURVES

On long radius curves, either horizontal or vertical, pipe may be installed with standard pipe by deflecting the joints. If the pipe is shown curved *on the Draw*ings and no special fittings are shown, the Contractor can assume that the curves can be made by deflecting the joints with standard lengths of pipe. If shorter lengths are required, the Drawings will indicate maximum lengths that can be used. The amount of deflection at each pipe joint when pipe is installed on a horizontal or vertical curve shall not exceed the manufacturer's printed recommended deflections. *The Contractor shall submit to the Engineer the pipe manufacturer's joint deflection recommendations prior to pipe installation indicating deflections are within allowable AWWA specification tolerances.*

Where field conditions require deflection or curves not anticipated *on the Draw*ings, the Engineer will determine the methods to be used.

When rubber gasketed pipe is installed on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

Maximum deflections at pipe joints and installation radius for various pipe lengths shall conform to the manufacturer's and AWWA specifications for the given type of pipe.

Where pipe installation on curves requires the use of special fittings, concrete blocking shall be used per Section 7-11.3(13).

Where restrained joint pipe is installed on a curve, the Contractor shall submit the pipe manufacturer's recommendations to the Engineer for approval at least 3 Working Days in advance.

7-11.3(5) CLEANING AND ASSEMBLING JOINTS

All parts of the pipe ends, couplings, fittings, and appurtenances shall be cleaned to remove oil, grit, or other foreign matter from the joint. Care shall be taken to keep the joint from contacting the ground.

Pipe not furnished with a depth mark shall be marked before assembly to ensure visual observation of the Work.

7-11.3(6) INSTALLING AND JOINTING PIPE

7-11.3(6)A INSTALLING AND JOINTING - DUCTILE IRON PIPE AND APPURTENANCES

The installation of ductile iron pipe and appurtenances shall be in accordance with AWWA C600.

Except where restrained joint systems are required, mechanical or slip joints may be used.

7-11.3(6)B INSTALLING AND JOINTING POLYETHYLENE ENCASED (FILM WRAPED) PIPE

Pipe with *polyethylene (film wrap) encasement* shall be installed in accordance with AWWA C105. The method used for encasing the pipe shall be approved by the Engineer. All damage to the polyethylene encasement shall be repaired at the Contractor's sole expense. Bedding and backfill shall be in accordance with Sections 7-10.3(9), 7-10.3(10), and 7-10.3(11).

7-11.3(6)C INSTALLING AND JOINTING MULTI-LAYERED POLYETHYLENE TAPE COATED PIPE

Pipe shall be hoisted from the trench side into the trench by means of a wide canvas or leather sling. Use of chains, cables, tongs or other equipment likely to cause damage to the lining or to the coating of the pipe will not be permitted. Dragging or skidding the pipe will not be permitted. The Contractor shall allow inspection of the coating on the underside of the pipe while suspended from the sling. *Any damage to the coating shall be repaired to a condition meeting the specified requirements before the pipe is lowered into the trench. Bedding and backfill shall be in accordance with Sections 7-10.3(9)A2, 7-10.3(10), and 7-10.3(11).*

At all times during construction of the *Water Main*, the Contractor shall use every precaution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the finished coating. Workers will be permitted to walk on the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. This shall apply to all surfaces whether bare, primed or coated. Any damage to the protective coating from any cause, prior to final acceptance of the *Water Main*, shall be repaired as directed by the Engineer and at the Contractor's expense.

Cutbacks on the spigot end shall be 6 inches or less and shall be made with a cutting device that is guided from the end of the pipe to ensure a straight, uniform cutback. No cutback shall be made on the bell end of the pipe.

Following the application of the outerwrap, the coating shall be electrically tested for holidays with a pulse tape holiday detector. The detector voltage range for this coating is 7000 to 9800 volts. The testing shall conform to NACE RP-02-74.

All holidays detected in the field shall be repaired by removing the outerwrap and primary coating from the damaged area, cleaning the exposed surfaces thoroughly and applying a suitable primer and tape to the exposed area as specified by the manufacturer. If required by the Engineer, the repaired area shall be outerwrapped after patching.

If the outerwrap is damaged and a holiday is not found in this area, the damaged outerwrap area shall be repaired by applying a patch as recommended by the manufacturer and approved by the Engineer.

If the outerwrap is damaged and a holiday is found, the damaged outerwrap shall be removed, taking care not to damage the inner coating. Before new outerwrap is placed, a holiday detector shall be applied to the exposed innerwrap to determine if it has been damaged during removal of the outerwrap. The outerwrap shall be installed as recommended by the manufacturer and approved by the Engineer.

After electrical bonds are installed and tested, the entire pipe joint and electrical bond strap shall be protected with a heat shrink joint sleeve. See Section 9-30.1(6)E Heat Shrink Joint Sleeve.

7-11.3(6)D INSTALLING RESTRAINED JOINT PIPE

The restrained joint Water Main to be installed shall be fully extended by pulling on the joint after the installation of the pipe segments as recommended by the manufacturer of the restrained joint pipe. When this newly installed Water Main is charged, bending or buckling of newly installed restrained joint Water Main will not be accepted. The Contractor shall submit the restrained joint manufacturer's recommendations to the Engineer at least 5 Working Days prior to pipe installation.

Restrained joint Water Main shall be installed as located on the Drawings. This work shall include all hardware and as necessary to perform this work.

7-11.3(7) INSTALLING STEEL PIPE

7-11.3(7)A THREADED STEEL PIPE LESS THAN 4 INCHES IN DIAMETER

Steel pipe in sizes up to and including 3-1/2 inches shall be connected with malleable iron screwed couplings. Couplings shall be galvanized. Unions or flanges shall be used at all equipment and valves. Cut ends shall be reamed and

threads cleanly cut. Exposed threads, after jointing, shall be brush-coated with an asphalt varnish, Royston Roskote Mastic R28 or approved equal.

7-11.3(7)B COUPLED PIPE 4 INCHES IN DIAMETER AND LARGER

Steel pipe 4-inch and larger, for use in underground services, shall be coupled as specified in the *Contract*.

Any welding of steel pipe shall be in accordance with AWWA C206.

Bell and spigot joints shall be thoroughly cleaned before assembly, and a lubricant suitable for potable water meeting the approval of NSF shall be brushed on the inside of the bell just prior to assembly.

7-11.3(7)C STEEL CASING PIPE

Where shown on the Drawings, the Contractor shall install steel casing pipe for the Water Main by an underground construction method as specified in Section 7-17.3(2)J.

All joints shall be welded by operators who have been qualified by tests as prescribed by the AWS in Standard Qualifications Procedure to perform the type of work required. The quality of welding shall conform to *the current edition* AWS D1.1 Structural Welding Code, Section 3, Workmanship.

Contractor shall submit to the Engineer for approval, an outline of the proposed construction procedure together with a listing of the Equipment for the work in accordance with the requirements of Section 7-17.3(2)J. In the event that the pipe is damaged during the installation and the defects cannot be corrected to a condition meeting the required Specifications, the Contractor shall be required to remove and replace the pipe.

7-11.3(7)D STEEL CASING SEALS AND SPACERS

Casing seals shall provide a moisture-proof seal that is resistant to heat, cold, vibration, impact, abrasions, fluids, disbonding, and expansion and contraction of the casing and the Water Main. Casing seals shall be installed according to the manufacturer's instructions.

The Crossing Insulators (Spacers) shall be composed of polyester fiberglass or polyvinyl chloride (PVC). The Material shall be resistant to abrasion and sliding wear. There shall be a minimum of two Crossing Insulators (Spacers) per length of pipe, and the spacing between spacers shall be no more than 10 feet apart. Crossing Insulators (Spacers) shall be installed per manufacturers instructions.

7-11.3(8) RESERVED

7-11.3(9) CONNECTIONS

7-11.3(9)A CONNECTIONS TO EXISTING *WATER* MAINS

The Contractor shall not operate any valve on an existing Water Main.

The SPU Water Operations will make all connections to charged Water Mains and will operate all valves to accomplish shutdowns and subsequent reactivation. Draining of existing Water Mains will be done by Water Operations staff. See Section 7-10.3(5) for verification of existing Water Main grade and alignment. The Contractor shall match the grade and alignment of the new Water Main to the existing Water Main. The excavation shall be sufficiently large to accommodate connection work as approved by the Engineer.

Connection points shall be verified in accordance with Section 7-10.3(5)B.

Installation of Water Mains and appurtenances, including pressure testing, and an acceptable bacteriological test, shall be completed and approved prior to making any connections.

The Contractor shall provide the Engineer 2 Working Days advance notice for scheduling inspections for approval of Water Main installations for connection. Within 2 Working Days after the inspection, the Contractor will be provided with written approval or with a list of items to be corrected. Items to be corrected will be reinspected. *The notification requirement and reinspection response times are the same as the initial inspection.*

Approval is contingent on the Water Main and appurtenances being completely installed and tested per Contract but does not require completion of *Street*, sidewalk and planting strip restorations. Water Main and appurtenances include all pipe, fittings, all blocking except temporary blocking, all hydrants, hydrant pads, blowoff assemblies, valves, flowmeters, chambers, corrosion protection, and coating systems.

Newly installed Water Main shall be pressure tested in accordance with Section 7-11.3(11) Hydrostatic Pressure Test and shall be flushed and disinfected in accordance with Section 7-11.3(12) Flushing and Disinfection of Water Mains.

After all tests, flushing, and disinfection have been successfully completed and the installed Water Main and appurtenances, including hydrants and valves, have been approved by the Engineer, it shall be the Contractor's responsibility to request the Engineer to schedule the shutdown(s) and connection(s) prior to surface restorations. In general, the Contractor's request for shutdown(s) and connection(s) *shall* be submitted to the Engineer at least 5 Working Days in advance of the desired date of the connection. However, the Contractor is encouraged to communicate and coordinate with the Engineer as early in the Project as possible regarding the scheduling of these connections as SPU Water Operations' shutting down and starting up portions of the water system *will* take into consideration:

1. Size of Water Main and total system impacts,
2. Coordination with fire and other needs,
3. End user needs and coordination, and
4. SPU Water Operation's workforce availability.

The Contractor's scheduling of connections requires the Engineer's approval. The excavation for the connection shall be completed, shored and dewatered, and all required materials and Equipment shall be available at the time of shutdown. Notifications of the scheduled shutdown will be made by SPU Customer Service / Inspection Services personnel to the affected consumers a minimum of 2 Working Days in advance of the scheduled shutdown. Connections must be made within 2 weeks of bacterial acceptance or the pipe must be retested.

The SPU will furnish connection fittings when specified in the Contract; otherwise, the Contractor shall furnish and install the connection fitting (see Standard Plan nos. 300a, 300b, and 300c). In addition, prior to and after connection of the new Water Main, SPU Water Operations will:

a. Deactivate Water Main;
b. Cut, remove, and dispose of pipe sections as necessary to install the new Materials;
c. Dewater existing pipe, as required, to perform SPU Water Operations connections;
d. Swab all connecting pipe and fittings with chlorine solution (5-6% Cl_2); and
e. Reactivate and flush the Water Main.

All fittings and other Materials and equipment not specifically called out in the Contract as being furnished by SPU Water Operations, required to complete the connection shall be furnished by the Contractor. The Contractor shall coat, wrap and joint bond the connection to conform with the requirements of the new Water Main.

The Contractor shall make all necessary excavation, protective measures, and backfill, and provide any equipment and operators required to move and lower the component parts of the connection into position. All temporary and permanent blocking shall be done by the Contractor.

In addition to those connections shown on the Drawings, segments of a new Water Main may be placed in service prior to completion of the entire Water Main. All connections between the charged and uncharged segments of the new Water Main will be done by SPU Water Operations personnel.

Locations of connections between segments of new *Water* Main are dependent on Contractor's operations and therefore are not shown. All Materials for such connections shall be furnished by the Contractor.

7-11.3(9)B MAINTAINING SERVICE

Where existing services are to be transferred from old to new Water Mains, the Contractor shall plan and coordinate the Work with that of SPU Water Operations so that service is resumed with the least possible inconvenience to customers.

To supply customers with water during the construction of a Project, where any section of pipe has passed *the required* hydrostatic and bacteriological tests, SPU Water Operations reserves the right to tap corporation stops into a section of a new *Water Main* and install corporation stops and service connections at such locations as SPU Water Operations deems necessary, at no expense to the Contractor. The attaching of any such service connections by the SPU Water Operation's shall not be construed by the Contractor as any acceptance by the Owner of any part of the Work required under the Contract.

7-11.3(9)C WATER SERVICE CONNECTIONS

See Section 7-15.

7-11.3(9)C1 INSULATED COUPLINGS AND FLANGE KITS

Insulated couplings and flange kits shall be installed to electrically isolate the *Water Main* from other Structures. Insulated joints shall be located at the locations indicated on the Drawings.

The Contractor shall carefully align and install insulating couplings and flange kits according to the manufacturers recommendations to avoid damaging insulating Materials. Coat all exposed surfaces of insulating flange, including fasteners, with petroleum-impregnated wax tape as specified in AWWA C217. *The Contractor shall submit to the Engineer for review, the manufacturer's installation recommendations at least 3 Working Days prior to use.*

7-11.3(9)D TEMPORARY WATER MAINS AND SERVICES

When called for in the *Contract*, SPU Water Operation's will install and maintain temporary Water Mains and services in such a manner as to provide constant adequate water supply to consumers and to avoid impeding *Traffic* and access to abutting properties.

The Contractor's critical path schedule shall allow adequate time for SPU Water Operations to install these facilities; a minimum of 2 weeks *advance* Written Notice shall be provided to the Engineer for scheduling of the temporary Water Main and service work.

SPU Water Operations will make all required excavation, backfill, and compaction as well as furnishing the necessary equipment and pipe for temporary Water Mains.

All temporary Water Mains will be chlorinated, flushed, and sampled for bacteriological testing by the SPU Customer Service / Inspection Services. If found acceptable, the temporary Water Mains will be placed in service.

7-11.3(10) LOCATING WIRE

Locating wire shall be installed 6 inches directly above the centerline of all non-metallic pipe, except that the locating wire shall be bonded by exothermic welds to all metallic fittings, valves and valve boxes to form an electrically continuous system.

7-11.3(11) HYDROSTATIC PRESSURE TEST

7-11.3(11)A GENERAL

All Water Mains and appurtenances shall be hydrostatically pressure tested. Once the new Water Main has passed the hydrostatic pressure test, the Water Main shall be flushed, disinfected, and bacteriologically sampled in accordance with Section 7-11.3(12).

All labor, equipment, pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and a 1/4 inch F.I.P.T. connection for pressure recorder, necessary for performing the test, shall be furnished and operated by the Contractor.

Pressure recorders and charts used to record the tests will be furnished and operated only by the Engineer.

The Contractor, prior to notifying the Engineer to witness and record the pressure test, shall have set up beforehand and successfully performed the pressure test to make certain that the pipe is in *acceptable* condition. The Contractor shall then notify the Engineer at least 2 Working Days before recording and conducting the test.

The Contractor shall furnish and install temporary blocking as required for pressure testing. Upon successful testing, temporary blocking shall be removed.

To protect existing Water Mains from contamination by backflow of test water during filling operations, an approved reduced pressure backflow assembly shall be temporarily installed between the test and supply Water Main. See Section 1-07.28 item 5D for notification requirements regarding BPD inspection. A current BPD performance test report shall be provided by the Contractor and shall be on the Project Site for the assembly being used. Prior to hydrostatic testing, the temporary backflow protection shall be installed and the Water Main under test isolated from the supply Water Main.

7-11.3(11)A1 TEST PRESSURE FOR FIELD TESTING WATER MAIN PIPE

Field hydrostatic testing of various diameter ductile iron Water Main pipes and appurtenances shall be as indicated *in the following table*:

Diameter Pipe (inches)	4	6	8	10	12	16 and larger
Test Pressure (psi)	300	300	300	300	300	250

Test pressure for pipe other than ductile iron will be indicated in the Contract.

The indicated test pressure shall be at the lowest elevation of the section of Water Main being tested. All air in the pipe shall be vented prior to test.

The hydrostatic test pressure shall be maintained until the Engineer has determined that the section of pipe, valves, and fittings are watertight. If there are no visible leaks and the test pressure is maintained without pumping for 15 minutes with a pressure drop of less than 15 psi, the *Water* Main will be accepted as a water tight installation. When testing short (less that 18 feet) lengths of *Water* Main pipe or when testing hydrant pipe, maintaining the test pressure without pumping for 5 minutes with less than 5 psi drop in pressure will be considered evidence of an *acceptable* test.

Sections to be tested shall be limited to 1,500 feet or less. The Engineer may require that the first section of pipe, not less than 1,000 feet in length, installed by each of the Contractor's crews, be tested in order to qualify the crew and the Material. Pipe installation shall not be continued more than an additional 1,000 feet until the first section has been tested successfully.

Hydrostatic tests shall be performed on every completed section of Water Main between valves. The pressure differential across closed valves shall not exceed the rated operating pressure of the valve.

All tests shall be made with the hydrant auxiliary gate valves open and with pressure exerted against the closed hydrant inlet valve. After the test has been completed, gate valves shall be tested by closing each one in turn and relieving the pressure beyond. This test of the gate valve will be acceptable if no immediate loss of pressure is registered on the gauge when the valve is being checked. The Contractor shall verify that the pressure differential across the valve does not exceed the rated test pressure of the valve.

Any visible leakage detected shall be corrected by the Contractor regardless of the allowable leakage specified above. Should the tested section fail to meet the pressure test as specified, the defects shall be located and repaired and the *Water Main* retested at the Contractor's *sole* expense.

Defective materials or workmanship discovered as a result of a hydrostatic field test shall be replaced and remedied by the Contractor. Whenever it is necessary to replace defective Material or correct the workmanship, the hydrostatic test shall be rerun until an *acceptable* test is obtained.

7-11.3(11)B TESTING EXTENSIONS FROM EXISTING *WATER MAINS*

When an existing Water Main is extended *over 18 feet*, the section of new pipe installed *to* the existing *Water* Main will be made by SPU Water Operations with pretested, pre-chlorinated pipe, and no hydrostatic test will be required. SPU Customer Service / Inspection Service shall be notified for approval at least 3 Working Days in advance if predisinfected pipe is proposed for installation. When the required hydrostatic tests are conducted in the new *Water* Main section beyond the installed new valve in the closed position, the normal pressure of the existing *Water* Main may be present against the other side of the new valve.

Where the distance between the end of an existing Water Main pipe extension to the new valve is more than 18 feet, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new valve, as close as possible to the existing pipe for testing purposes. Where a new valve is

not part of the Work, the Contractor shall notify the Engineer at least 10 Working Days in advance to coordinate other arrangements for hydrostatic testing.

The short length of pipe between the temporary cap or plug end with the new valve in the closed position, with no hydrostatic pressure active on the opposite side of the valve, shall be subjected to the required test pressure. The same test shall be made against the other side of the new valve when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing *Water* Main pipe. The final connection to the existing *Water* Main shall be made by the SPU Water Operations with pretested, pre-chlorinated pipe, and no hydrostatic test will be required.

7-11.3(11)C TESTING SECTION WITH HYDRANTS INSTALLED

When hydrants are included with the section of *Water* Main pipe to be tested, the testing shall be conducted in three separate tests as follows:

Test No. 1	Water Main gate valves and hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.
Test No. 2	Water Main gate valves and the hydrant operating the stem valves tightly closed but the hydrant auxiliary gate valves and hose ports wide open.
Test No. 3	Each hydrant shall be tested to 200 psi with the hydrant auxiliary gate valve and hose ports closed and the hydrant operating stem valve wide open. Twenty-five pounds per square inch shall be in the supply Water Main beyond the hydrant auxiliary gate valve when testing a hydrant singly.

7-11.3(11)D TESTING HYDRANTS INSTALLED ON EXISTING *WATER* MAINS

For hydrants installed and connected to an existing *Water* Main, the hydrant connection including hydrant tee, connection pipe, and auxiliary gate valves, shall be installed with pretested Materials.

Before the hydrant connection is made to the existing *Water* Main, the hydrant installation shall be subjected to the hydrostatic Test No. 3 as specified in Section 7-11.3(11)C. *Following an acceptable hydrostatic test, hydrants installed and connected to an existing Water Main shall have a bacteriological sample obtained and tested for acceptable results before connection the Water Main*.

7-11.3(12) FLUSHING AND DISINFECTION OF WATER MAINS

7-11.3(12)A GENERAL

Before being placed in service, all newly installed pipe, valves, hydrants, and appurtenances shall be flushed, disinfected and kept clean, and an *acceptable* bacteriological report shall be obtained.

Newly installed Water Mains exceeding 500 feet continuous length shall have a bacteriological sample taken from each and every 500 foot interval of Water Main in addition to samples taken at each end of the Water Main. For each hydrant lateral over 18 feet in length, a bacteriological sample shall be taken at the hydrant end. Hoses for bacteriological sampling will not be allowed. On new Water Mains without hydrants, temporary sampling taps shall be provided, and then removed and plugged after *acceptable* bacteriological results have been verified. Hydrants used for bacteriological sampling shall be fitted with a sampling tap acceptable to the Engineer.

SPU's Water Quality Laboratory will perform the bacteriological test and report the results to the Engineer. Results will be available to the Engineer no earlier than 48 hours after samples are delivered to SPU's Water Quality Laboratory. *Bacteriological sample results are valid for 14 Days after date of sample collection. If connections are not made within that time period, the Water Main shall again be flushed and another acceptable bacteriological test result shall be obtained*. SPU's Water Quality Division may require bacteriological samples at any time.

7-11.3(12)B PRE-DISINFECTION FLUSHING

Sections of pipe smaller than 24-inch diameter to be disinfected by methods other than that found in Section 7-11.3(12)D, METHOD 1, shall first be flushed to remove any solid or contaminated material. If METHOD 1 is used, the 2-1/2 fps flushing shall be done after disinfection is complete (see Section 7-11.3(12)L, Final Flushing and Testing). If no hydrant is installed at the end of the new pipe, the Contractor shall provide a tap large enough to develop a velocity of at least 2.5 feet per second in the pipe. Flushing period shall be at least 5 minutes for every 150 feet of new pipe but in no case less than 30 minutes. One 2-1/2 inch hydrant opening will, under normal pressure of 40 psi, provide this velocity in pipe sizes up to and including 12 inches. For pipe sizes exceeding 12-inch diameter, flushing taps size requirements are:

REQUIRED FLOW AND OPENING TO FLUSH *WATER MAINS*		
Pipe Diameter (inches)	**Flow Required to Produce 2-1/2 feet per second (fps) Velocity in *Water* Main (gpm)**	**Number - Size (inch) of Taps Required for a 2-1/2 fps Flush**
14	1200	3 - 2", or 1 - 3"
16	1600	4 - 2", or 1 - 4"
20	2500	6 - 2", or 3 - 3", or 2 - 4"
24	3600	4 - 3", or 2 - 4", or 1 - 6"
30	5625	4 - 4", or 2 - 6", or 1 - 8"
36	8100	2 - 6", or 1 - 8"
42	11025	3 - 6", or 1 - 10"
48	14400	4 - 6", or 1 - 12"

Taps required for chlorination, flushing or temporary or permanent release of air shall be furnished and installed by the Contractor and are incidental to the construction of Water Mains. When a hose bib faucet is installed for bacteriological sampling, it shall be located upstream from the flushing point. Taps on existing *Water* Mains required for chlorination or flushing will be furnished and installed by SPU's Water *Operations* Division.

As an alternative to 2-1/2 fps flushing, sections of pipe 24 inches or larger diameter may be prepared for disinfection by mechanical cleaning methods approved by the Engineer.

The Contractor shall be responsible for disposing of treated water flushed from the Water Mains in a manner acceptable to state and local authorities. The water shall be neutralized before disposal into any natural drainage channel. The Contractor shall maintain an air gap equal to twice the discharge pipe/hose diameter (but not less than 12 inches) between the discharge outlet and the overflow rim of the receiving waters.

7-11.3(12)C REQUIRED CONTACT TIME

Before being placed into service, all newly installed pipe shall be disinfected so that a chlorine residual of not less than 10 mg/L remains in the water after the retention period. Treated water shall be retained in the pipe at least 24 hours. If the water temperature is less than 41ºF (5ºC), the water shall remain in the pipe for at least 48 hours. After the retention period, chlorine residual shall be tested at all extremities of the pipe and shall measure at least 10 mg/L. If a measurement of less than 10 mg/L is obtained repeat disinfection is required.

7-11.3(12)D FORM OF APPLIED CHLORINE

Chlorine shall be applied by one of three methods to give a dosage of not less than 25 mg/l of available chlorine:

METHOD - 1 Dry Calcium Hypochlorite

As each length of pipe is installed, sufficient high test calcium hypochlorite (65 -70% chlorine) shall be placed in the pipe to yield a dosage of not less than 25 mg/l available chlorine, calculated on the volume of the water to be contained in the pipe and appurtenances. This method may only be used if the pipes and appurtenances are kept clean and dry during construction.

The number of ounces of 65% test calcium hypochlorite required for a 20 foot length of pipe equals $0.004216d^2$ in which "d" is the pipe diameter in inches.

METHOD - 2 100% Gas Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device. Chlorinating devices for feeding solutions of the chlorine gas *shall* provide means for preventing the backflow of water into the chlorine supply. *See Section 1-07.28 item 5D regarding BPD notification and testing requirements.*

METHOD - 3 Sodium Hypochlorite

Sodium Hypochlorite, commercial grade (12.5% Cl_2) or in the form of liquid household bleach (5 - 6% Cl_2), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the *Water* Main with fill water in correct proportion to produce a mixture of at least 25 mg/l Cl_2.

7-11.3(12)E CHLORINE DOSAGE

The amounts of chlorine (Cl_2) required to give 25 mg/l for 100-foot lengths of various diameters of pipe are:

AMOUNTS OF CHLORINE REQUIRED FOR 25 MG/L DOSAGE				
Pipe Size (inch)	**Volume of Water per 100 ft Length** (gallons)	**Cl_2 100%** (lbs)	**Household Bleach 5-1/4% Cl_2** (gallons)	**Commercial Bleach 12-1/2% Cl_2** (gallons)
4	65.3	.014	.03	.013
6	146.5	.031	.07	.03
8	261.0	.054	.13	.053
10	408.0	.085	.2	.08
12	588.7	.121	.3	.12
14	799.6	.167	.4	.16
16	1044.4	.22	.5	.21
20	1631.9	.34	.8	.33
24	2349.9	.49	1.1	.47
30	3671.7	.77	1.8	.75
36	5287.3	1.1	2.5	1.1
42	7196.6	1.5	3.5	1.44
48	9399.0	2.0	4.6	1.6

7-11.3(12)F POINT OF APPLICATION FOR LIQUID/GAS DISINFECTION

The preferred point of application of the chlorinating agent is at the beginning of the *Water Main* extension or any valved section of it and through a corporation stop inserted in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe shall be supplied from a tap on the pressure side of the gate valve controlling the flow into the *Water Main* extension. Alternate points of application may be used when approved by the Engineer.

7-11.3(12)G BACKFLOW PREVENTION REQUIREMENT

To prevent contaminated water from the new Water Main from entering the existing distribution system, an approved reduced pressure backflow assembly shall be used on the line supplying the water. An approved reduced pressure backflow assembly is sufficient backflow protection only for filling and flushing of the new Water Main. During the hydrostatic pressure test, the temporary connection between the new Water Main and the existing distribution system shall be removed. See Section 1-07.28 item 5D for backflow prevention device (BPD) notification and testing requirements.

7-11.3(12)H RATE OF APPLICATION

Water from the existing distribution system, or other approved supply source, shall be controlled for very slow flow into the newly installed Water Main during chlorine application. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly installed pipe that the dosage applied to the water is at least 25 mg/l.

Sodium hypochlorite, commercial grade (12.5% Cl_2) or in the form of liquid household bleach (5-6% Cl_2), may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the *Water* Main in correct proportion to the fill water so that dosage applied to the water is at least 25 mg/l.

7-11.3(12)I RESERVED

7-11.3(12)J RESERVED

7-11.3(12)K DISINFECTION OF CONNECTIONS TO EXISTING WATER SYSTEMS

All connections shall be disinfected per the requirements of AWWA C651 section titled “Disinfection Procedures When Cutting into or Repairing Existing Main”. All pipe and fittings shall be swabbed or sprayed with a chlorine solution at least as strong as liquid household bleach (5-6% Cl_2).

7-11.3(12)L FINAL FLUSHING AND TESTING

Following chlorination, all treated water shall be flushed from the pipe until the replacement water treated throughout its lengths shows an absence of chlorine. If chlorine is normally used in the source of supply, tests shall show a residual not in excess of that carried in the system.

Where dry calcium hypochlorite has been used for disinfection, flushing velocity *shall* be at least 2.5 feet per second in the *Water* Main. Flushing period shall be at least 5 minutes for every 150 feet of new *Water* Main but in no case less than 30 minutes.

Bacteriological samples shall be collected at intervals of 500-feet and at the ends of the new Water Mains. No hoses shall be used in collection of samples. If hydrants are not available on the new Water Main to facilitate collection of samples, temporary sampling taps shall be installed by the Contractor. Sampling taps shall be removed and plugged after *acceptable* bacteriological results are obtained. If hydrants are used for collection of bacteriological samples, they shall be fitted with a sampling tap.

All hydrants on the new *Water* Main shall be flushed to remove excess chlorine from the hydrant and hydrant branch.

7-11.3(12)M REPETITION OF FLUSHING AND TESTING

Based on any *unacceptable* bacteriological sample results, the new *Water* Main shall be either flushed and re-sampled, or re-disinfected, flushed and re-sampled. These procedures shall be repeated by the Contractor until *acceptable* bacteriological sample results are obtained.

7-11.3(13) CONCRETE THRUST BLOCKING

Concrete thrust blocking, as indicated on Standard Plan nos. 330a through 331b, shall be placed at bends, tees, deadends, and crosses as located on the Drawings. Blocking shall be Class 5 (1-1/2) (see Section 5-05.3) concrete mix poured in place.

Concrete blocking shall bear against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

The Contractor shall provide the Engineer at least 1 Working Day advance notice for inspection and approval of all concrete blocking prior to backfilling. Unacceptable concrete blocking shall be replaced at the Contractor's expense.

7-11.3(14) BLOWOFF ASSEMBLIES

Water Main blowoff assemblies shall be constructed as shown on the Drawings or Standard Plan nos. 340a and 340b. A standard meter box shall be installed in non-*Traffic* bearing areas; a Type 361 Frame and Cover shall be used for all other installations subject to vehicular *Traffic*. Care shall be taken in locating the meter box or frame and cover such that it is not in any water course or in any other location subject to drainage or sewerage contamination. Tops shall be set to conform to finished grade. Backfilling and compaction shall conform with Sections 7-10.3(10) and 7-10.3(11).

Drilling and tapping into the Water Main shall be performed by the Contractor except in the event of installation on a charged (in-use) Water Main, in which case SPU Water Operations will make the connection.

7-11.3(15) ELECTROLYSIS MONITORING SYSTEM FOR DUCTILE IRON PIPE

7-11.3(15)A GENERAL

Where called out on the Drawings, the *Water Main* Contractor furnishing the pipe shall comply with the following:

1. **Install Electrical Continuity Bonds:** The Contractor shall furnish and install electrical joint bonds, as specified herein, at all mechanical coupling non-insulated flange joints and all rubber gasket joints. The Contractor shall take special precautions to avoid disturbing existing bonds, electrical cables, and wires for test stations and other cathodic protection equipment connected to, or installed near the *Water Main*.
2. **Install Electrolysis Test Stations:** The Contractor shall furnish and install the Electrolysis Test Stations where shown, and as detailed on the Drawings.

7-11.3(15)B ELECTRICAL JOINT BONDS FOR ALL DUCTILE IRON PIPES AND FITTINGS

7-11.3(15)B1 GENERAL

Each length of ductile iron pipe in the *Water Main*, and each hydrant run, shall be electrically bonded together, and each mechanical joint shall be bonded to the pipe as shown on the Drawings. The Contractor shall make adhesion tests of all bonds and bonded joints in the presence of the *Engineer.* Any bonded joint which fails to meet the adhesion test shall be rebonded until an *acceptable* test is obtained. Bonding cable shall be as specified in Section 9-30.10.

Details of mechanical joint bonding shall be as shown in Standard Plan no. 362.

7-11.3(15)B2 JOINT BOND CABLE CONNECTIONS FOR DUCTILE IRON PIPE

Prior to making any bond connection to metal, a 2 inch x 2 inch section of coating materials shall be removed from the pipe surface to make the connection. Paint, primer, and coating material shall be removed from the pipe surface with clean rags and solvent prior to preparing the metal surface. The metal surface shall be cleaned to white metal by sandblasting, grinding, or filing prior to welding the conductor. Resin-base grinding disks shall not be used. Ceramic base disks are acceptable. Joint bonding cable shall be welded to the pipe or fitting by the exothermic process with a copper sleeve fitted over the exposed conductor. Only sufficient insulation shall be removed from the bonding cable to allow placing of the welding mold. After the weld is completed it shall be tested in accordance with Section 7-11.3(15)D.

Defective welds shall be removed and replaced.

Exposed metal surfaces around the thermite weld including the end of the copper conductor, and the weld itself, shall be covered with coating material as shown on the Drawing or in accordance with Section 9-30.11(3).

The Contractor shall provide the Engineer sufficient advance notice so that all connections to pipe obtain inspection and approval prior to covering. Bond connections not receiving Engineer inspection prior to cover or backfill will be rejected.

7-11.3(15)B3 RESERVED

7-11.3(15)B4 TESTING ELECTROLYSIS TEST STATION

The Contractor shall notify the Engineer, in writing at least 72 hours in advance, to perform a functional test of the electrolysis test station before backfilling.

7-11.3(15)C ELECTROLYSIS TEST STATION

7-11.3(15)C1 GENERAL

Electrolysis Test Stations shall be installed as indicated on Standard Plan no. *360.*

7-11.3(15)C2 ZINC REFERENCE ELECTRODES

Place reference electrode within the *Water Main* trench excavation 6" horizontally from the Water Main at or just below the springline. An exception is where Water Main crosses any other metallic pipe in which the electrode is to be placed between the Water Main and the other pipe. Reference electrodes shall be backfilled with suitable Material. Terminate wires in the test stations.

7-11.3(15)C3 TEST STATION

The test station shall consist of a molded *test station* box installed inside a conventional cast iron water meter box for non-*Traffic* areas or inside a Type 230 frame and cover for *Traffic* areas. The cover shall have the letters "WATER" cast into it.

7-11.3(15)C4 TEST WIRES

Wire location, connections to pipe, size, insulation color, and crimp-on wire connectors shall be as shown on the Standard Plan no. 363.

7-11.3(15)D THERMITE WELD CONNECTIONS

Each bond connection shall be insulated thoroughly with a Royston Handy Cap or approved equal. The cap shall completely cover the cleaned area and provide insulation of the bond connection from the soil environment. The cap *shall* be attached by use of a bonding cement or primer and *shall* contain an elastomeric Material under a plastic dome. The elastomeric Material *shall* mold completely around the bond wire and weld area. The cap shall be a minimum of 4 inches x 4 inches x 125 mils thick. Caps are not required when the connection is covered by heat shrink joint wrapping.

7-11.3(15)D1 TESTING EXOTHERMIC WELD CONNECTIONS

After the exothermic weld has cooled, slag shall be removed and the weld tested with a glancing blow with a 16 ounce hammer to assure proper metallurgical bond.

7-11.3(16) ELECTRICAL INSULATION OF WATER MAIN

7-11.3(16)A GENERAL

The Water Main shall be installed so as to maintain electrical insulation from dissimilar pipe material, other water Structures, and other underground installations.

7-11.3(16)B TESTING OF INSULATING COUPLINGS OR INSULATING FLANGE KITS

Insulating couplings or insulating flange kits shall be located and installed as shown on the Drawings. The Contractor shall install an electrolysis test station at each insulating device. The Contractor shall notify the Engineer or SPU corrosion Engineer at least 72 hours in advance to perform a functional test of the insulating couplings and flange kits. The Engineer will test the insulating device. Defective insulating devices shall be repaired at the Contractor's sole expense. All damaged or defective insulating materials shall be replaced.

7-11.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Pipe, Water Main, (Material), (Class), (Size), including Fittings", will be per linear foot based on the slope distance from point to point. The point of beginning or ending of measurement in any particular run of pipe will be either with the vertical intersection of the center line of the intersecting pipe, or with the beginning or ending of any new pipe installed. No deductions will be made for the linear length of fittings, valves, couplings, etc. contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement will be taken as the midpoint of the reducer.

Measurement for "Blocking, Cement Concrete" will be by the cubic yard of concrete placed as computed by the Engineer.

Measurement for "Blowoff Assembly, (Size)" will be per each complete blowoff assembly installed which includes not in excess of 10 feet more than the length of blowoff connection pipe indicated on the Drawings as part of the each.

Measurement for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" will be per linear foot actually installed.

Measurement for "Station, Electrolysis Test" will be per each installed complete.

7-11.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-11 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings**", per linear foot.

The *Bid item price* for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including Fittings" shall *include all costs for the work required as follows*:

(1) Costs required for excavating, installing and joining pipe, backfilling and compacting native material, and disposing of and/or placing excess native material elsewhere;

(2) Cost of Materials, including but not limited to: the pipe, fittings and pipe supports, locating wire, special coatings, and other items called for in the *Contract*. Where required, the costs of sand or foam cushioning between the Water Main and other pipes shall also be included;

(3) Costs for the work required to furnish and install mechanical joint sleeves and pipe supports, including pipe hanger rods with nuts, single pipe rolls, steel angles, reinforcing bars, nuts, bolts, washers, mastic, and galvanizing;

(4) Costs required to perform the "Taste Rating Test Procedures", "Procedures for Hydrostatic Pressure Testing", and "Procedures for Flushing, Disinfection and Bacteriological Sampling of New Water Mains";

(5) Costs necessary for installing pipe on curves as shown *on the Draw*ings, including field changes involving standard lengths of pipe deflected at the joints;

(6) Costs of all Material, labor and equipment associated with making pipe connections *unless otherwise specified*; and

(7) Costs of furnishing and installing service connecting tees 4-inches and larger.

Special fittings used but not called for on the Drawings will be paid for at the Supplier's invoice cost plus 15 percent for overhead and profit. Special fittings called for on the Drawings but not used will be deducted from the Contractor's final estimate based on the current cost to the Supplier of fittings used on the Improvement.

If the pipe, its lining or its coating is damaged, the Contractor will be required, at the Contractor's sole expense, to repair the damage to an acceptable condition prior to installation.

Payment for safety systems required for trench excavation work *will* be in accordance with Section 7-17.5.

Defective materials or workmanship discovered as a result of tests shall be replaced and retested by the Contractor at the Contractor's own expense *(see Section 1-05.7)*.

2. "**Blocking, Cement Concrete**", per cubic yard.

The Bid item price for "Blocking, Cement Concrete" shall include all costs for the work required as follows:

(1) Costs of placing concrete blocking including: excavation, turnbuckles, shackle rods, steel plates, concrete form work, finishing, removal and disposal of material not required for backfill; and

(2) Other work that may be necessary for constructing the blocking in place as specified.

3. "**Blowoff Assembly, (Size)**", per each.

The Bid item price for "Blowoff Assembly, (Size)" shall include all costs for the work required as follows:

(1) Costs for furnishing and installing the complete assembly including corporation, fittings, pipes, valve, meter box or ring and cover, and all excavation, backfill with native material and compaction;

(2) Costs to furnish and install the pipe between the corporation and the blowoff assembly including fittings; and

(3) If the location of the blowoff assembly differs from that shown *on the Draw*ings and requires an increase of more than 10 feet of connection pipe, the excess of pipe over 10 feet will be paid for in accordance with Section 1-09.4.

4. "**Steel Casing Pipe, (*Class*), (Size), (*Underground Construction Method)***", per linear foot.

The Bid item price for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)" shall include all costs for the work required as follows:

(1) *Costs for furnishing and installing the casing pipe by the underground construction method including but not limited to excavation and backfill of jacking pit(s); furnishing and placing sand filler, spacers, and sealing both ends with concrete; and installing, maintaining, and removing jacking pit support system; and*

(2) Costs to remove and replace damaged steel casing pipe deemed necessary by the Engineer.

5. "**Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)**", per linear foot.

The Bid item price for "Pipe, Water Main, (Material), (Class), (Size), (Coating), including fittings, (Underground Construction Method)" shall include all costs for the work required to furnish and install the pipe, including placing the designated fill in the annular space when applicable.

6. "**Station, Electrolysis Test",** per each.

The *Bid item price* for "Station, Electrolysis Test" shall include *all costs for the work required as follows*:

(1) Costs of furnishing and installing water meter box, test box, terminal blocks, wires, zinc reference electrodes, removal and restoration of sidewalks; and

(2) All other Materials and labor required to complete *this construction*.

*7. "**Bedding, Water Main, (Class), (Size) Pipe",** per linear foot.*

The Bid item price for "Bedding, (Class), (Size) Pipe" shall include all costs for the work required to furnish and install bedding to the cross section shown in Standard Plan no. 350. Cost of Class D bedding shall be included in the Bid item price for pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

8. **Other payment information**.

No separate payment will be made for electrical joint bonds. Costs for labor, Material and Equipment required to *acceptably* bond across mechanical couplings and across rubber gasket joints, and all incidentals required to provide *acceptable* and complete bonding shall be included in the *Bid item price* for "Pipe, Water Main, (Material), (Class), (Size), including Fittings".

Joint bonding Material shall include without being limited to all required cables, bolts, molds, cold applied tape coatings and heat shrink sleeves.

SECTION 7-12 VALVES FOR WATER MAINS

7-12.1 DESCRIPTION

Section 7-12 describes work consists of furnishing and installing all Water Main valves and valve accessories as indicated in the Contract, and supplying all materials, tools and appurtenances needed to complete the installation.

7-12.2 MATERIALS

Materials shall meet the requirements of Section 9-30.3.

Valves for Water Mains shall be suitable for ordinary waterworks service and are intended to be installed in a normal position on buried Water Mains for water distribution and water transmission systems.

7-12.3 CONSTRUCTION REQUIREMENTS

7-12.3(1) GENERAL

The Contractor shall not operate any valve on an existing Water Main.

All valves shall be inspected upon delivery in the field to ensure proper working condition before installation and to verify free of rust and dirt. The valves shall be set and jointed to the pipe according to the AWWA Standards, unless indicated otherwise on the Drawings, for the type of connecting ends furnished. The valves shall be carefully inspected for damage to the outer protective coating(s) and verified damage free prior to installation.

An operating nut extension shall be installed when the ground surface is more than 30 inches above the valve operating nut. In standard valve boxes, which contain valves 12 inch and smaller, the operating nut extension shall extend into the top section of the standard valve box (see Standard Plan nos. 315a and 315b). In vaults, which contain valves greater than 12 inch, the operating nut extension shall extend into the upper section of the vault and shall clear the bottom of the lid within a range of 24 to 30 inches. The Contractor shall be prepared to furnish and install an operating nut extension when required. Upon delivery at the Project Site, all valves shall be opened to prevent the collection of water in the valve. Valves shall have the interiors cleaned of all foreign matter and shall be inspected both in open and closed position prior to installation. Valves shall be set *perpendicular to the Water Main. Valve boxes shall be placed over the 12 inch and smaller valve or valve operator and any extension in a manner that the valve box makes no contact with the valve assembly or extensions and does not transmit shock or stress to the valve assembly or Water Main (see Section 7-12.3(4)). The lower casting of the valve box shall be installed first, so as to be supported by backfill and a polyethylene foam collar not less than 2 inches in thickness. The casting shall not rest directly upon the body of the valve or upon the Water Main. Backfill shall be carefully tamped around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench if it is closer. The cast iron valve box cover shall be set flush to finished grade*.

The combination air release/air vacuum valves shall be installed as shown *on the Draw*ings. All piping shall be sloped to permit escape of any entrapped air. Backfilling and compaction shall be as specified in Section 7-10.

After installation, all valves shall be field tested (see Sections 7-11.3(11) and 7-11.3(12)) and disinfected. Should any defects in design, Materials installation, or workmanship appear during these tests, the Contractor shall correct such defects to an acceptable condition as determined by the Engineer.

7-12.3(2) VALVE CHAMBERS

7-12.3(2)A GENERAL

This Section deals with the construction of valve chambers and special valve chambers.

Where shown on the Drawings, valve shall be enclosed in a valve chamber.

Valve chambers may be either precast or cast in place. The use of solid concrete blocks or concrete brick will be allowed only when indicated in the Contract.

Valve chambers and the casting assembly for valves larger than 12 inch shall make no contact with the valve assembly or extension where surface shock or stress can be transmitted to the valve assembly or Water Main.

7-12.3(2)B PRECAST VALVE CHAMBERS

The concrete base shall be poured-in-place or precast. Poured-in-place base shall be allowed to attain sufficient strength to support the chamber (usually 2 or 3 Days), as *approved* by the Engineer. Precast chambers shall be set on the concrete base in cement mortar. *The vault chamber shall have adequately sized and located openings for chamber installation adequately clear of the Water Main*.

The Water Main shall be wrapped with 2-inch thick plastic foam Material at those areas where the Water Main intersects the chamber walls. The plastic foam Material shall cover the Water Main the full width of the chamber wall. Any remaining space between the chamber wall and the plastic foam Material shall be filled with cement mortar, and when the opening is large enough, brick and mortar. In no case shall the Water Main rest on the chamber wall.

7-12.3(2)C CHAMBERS MADE WITH PRECAST CONCRETE BLOCKS

Circular or rectangular chambers may be made with solid precast concrete blocks. The base shall first be poured in place. After the base has reached sufficient strength (usually 2 or 3 Days), the walls may be constructed of concrete blocks with water-tight cement mortar joints.

Circular chambers shall be constructed with curved manhole blocks. The chamber top shall be tapered in to the dimensions shown on the Standard Plans.

Chambers shall have a cast-in-place or precast concrete top slab suitable for H 20 *Traffic* loading.

7-12.3(2)D CAST-IN-PLACE CHAMBERS

Cast-in-place chambers may be constructed by using forms and poured concrete. Finishing of walls is not required other than the patching of porous spots (rock pockets) and bolt holes. Forms shall be removed for inspection of concrete.

7-12.3(3) SETTING FRAME AND COVER

The cast iron frame and cover *(see Standard Plan no. 351)* shall be set to grades furnished by the Engineer. Provisions for future adjustment of frame to changes in grade shall be made by constructing a minimum of 2 courses of brick with mortar joints between the top of the chamber and the bottom of the casting. Brick for this purpose shall be standard concrete brick 2-1/4 inches thick. *When the casting is in concrete pavement or in rigid concrete base, reinforcement within the concrete pavement slab shall in accordance with Section 5-05.3(9).*

7-12.3(4) SETTING VALVE BOX

Cast iron valve boxes shall be positioned during backfilling operations to be in vertical alignment with the gate valve operating stem. The lower casting of the unit shall be supported by a plastic foam collar not less than 2 inches thick, and shall be held in place by carefully compacted backfill. The casting shall not rest directly upon the body of the gate valve, *operating nut extension*, or upon the Water Main. *The upper casting of the valve box shall be placed in the plane of and flush with the finished grade, and when installed on slopes may both need to be tilt adjusted and adequately offset to provide valve and extension clearances meeting the requirements of Section 7-12.3(1) and allow straight and direct access to the operating stem.*

Compaction shall be as specified in Section 7-10.3(11).

7-12.3(5) VALVES INSTALLED ON SPECIALLY COATED PIPE

Valves installed on Water Mains that are polyethylene encased, tape coated, or special coated, shall be *polyethylene* encased, *epoxy coated*, or special coated the same as the Water Main.

7-12.3(6) LADDERS

Refer to Section 7-05.3(1)Q.

7-12.3(7) PAINTING OF VALVES

7-12.3(7)A PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specification TT-V-51A or approved equal.

7-12.3(7)B PAINTING IN THE FIELD

The valve shall be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base, and the cleaned area shall then be recoated with the manufacturer's recommended primer and the entire valve shall be field painted with two or more coats of Royston Roskote 612XM, or equal, per manufacturer's instructions.

7-12.3(8) THERMOPLASTIC POWDER COATING

Valves and attachments to be installed on Water Mains where the Contract specifies Thermoplastic Powder Coating for the Water Main, shall also have the same Thermoplastic Powder Coating. An exception is specified in Section 7-14.3(10) regarding hydrants.

7-12.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

7-12.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-12 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Valve, Gate, (Size)",** per each.
2. **"Valve, Butterfly, (Size)",** per each.

The *Bid item price* for "Valve, (Type), (Size)" shall include all costs for the work required to furnish and install the valve, including painting, jointing, disinfecting, hydrostatic testing, operating nut and extensions.

When the valve is to be polyethylene encased, thermoplastic powder coated, or epoxy coated as indicated in the Contract, the cost for furnishing and installing the coating as specified in Section 7-12 shall be included in the Bid item price for "Valve, (Type), (Size)".

3. "**Valve Chamber, (Type), (Size)",** per each.

The *Bid item price* for "Valve Chamber, (Type), (Size)" shall include all costs *for the work* required to furnish and install the precast concrete, brick and block, or cast-in-place chamber, including foundation, adjustment brick, castings and lid, ethafoam cushion, mortar plastering, valves, support piers, water proofing Materials and steps or ladders.

4. "**Valve Box, Cast Iron**", per each.

The *Bid item price* for "Valve Box, Cast Iron" shall include all costs *for the work required* to furnish and install the valve box, including plastic foam cushion.

SECTION 7-13 RESERVED

SECTION 7-14 HYDRANTS

7-14.1 DESCRIPTION

See Section 2-07.3 regarding hydrant use.

These Specifications are to be used in conjunction with the AWWA Standard C502 for dry barrel hydrants for ordinary water works service.

Section 7-14 describes work consisting of installing and setting and adjusting hydrant; and furnishing, installing and setting the hydrant tee, auxiliary valve, restraint system and shackles, gravel drain, concrete blocks, shear block, bleeder, hydrant connection, connection pipe, *marker posts*, retaining wall and rock facing, coating, painting, excavation, backfilling, furnishing and installing hydrant markers and quick connect adapters when required, and other pertinent Work as specified in other Sections of this Specification. The work also includes flushing, hydrostatic pressure testing and disinfecting of furnished hydrants and hydrant barrel extensions. The Contractor shall check and tighten any loose bolts on the hydrant prior to installation.

Hydrants will be furnished by SPU Water Operations. When required by the Engineer, hydrant barrel extensions kits will be furnished by SPU and installed by the Contractor prior to hydrant pressure testing. The Contractor shall take delivery of, and responsibility for, hydrants and extension kits provided at the Water Operations Center (2700 Airport Way South, Seattle) and shall transport them to the job site. The Contractor shall notify the Engineer at least 5 Working Days in advance to schedule hydrant pick-up and extension kit pick-up, and *at least* 2 Working Days in advance for hydrant installation. One hydrant extension kit, sized as determined by the Engineer, will be provided for each hydrant requiring adjustment. The Contractor shall flush, test and disinfect furnished hydrants and hydrant barrel extensions according to Section 7-11.3.

7-14.2 MATERIAL

Materials shall meet the requirements of Section 9-30.

Hydrants will be furnished by SPU. Arrangements for hydrant pickup will be addressed per Section 1-08.1(2).

7-14.3 CONSTRUCTION REQUIREMENTS

7-14.3(1) SETTING HYDRANTS

Where shown on the Drawings, hydrants shall be installed in accordance with the detail shown on Standard Plan nos. 310a through 314. Hydrants shall not be installed within 3 feet of a traveled roadway. In addition, a minimum 4-foot radius unobstructed working area shall be provided around all hydrants. The sidewalk flange shall be set 2-inches minimum and 7-inches maximum above finished grade.

For each hydrant requiring vertical adjustment, see Section 7-14.1.

Any barrel adjustment riser, less than 28" in length, shall be buried at the bottom of the hydrant center section, rather than at the bottom of the hydrant curb stand or discharge section.

After installation hydrants shall be subjected to a hydrostatic test as specified in Section 7-11.3(11).

The hydrant excavation shall be backfilled when installation and testing are complete and accepted by the Engineer.

A concrete shear block, as shown by the hydrant details on Standard Plan nos. 310a through 311b, shall be constructed if the hydrant is not in a concrete sidewalk. Construction, Materials, and finishing of the concrete shear block shall conform with Section 8-14, Cement Concrete Sidewalk. The shear block shall be set flush with the immediately surrounding finish grade.

After all installation and testing is completed, the hydrants shall be painted in accordance with Section 7-14.3(11).

Any hydrants not in service shall be identified by covering with a burlap or plastic bag.

7-14.3(2) HYDRANT CONNECTIONS

7-14.3(2)A GENERAL

Hydrant laterals shall consist of a section of 6-inch ductile iron pipe from the *Water* Main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the Standard Plans.

7-14.3(2)B HYDRANT RESTRAINT

Hydrants shall be restrained with two 3/4-inch diameter steel shackle rods as shown on the Drawings. Threads shall be cut at the ends or where rod couplers are needed. "All Thread" rod will not be allowed. Shackle rods shall be completely coated pursuant to Section 9-30.15.

7-14.3(2)C AUXILIARY GATE VALVE AND VALVE BOX

Auxiliary gate valves and boxes shall be installed in accordance with Section 7-12 except that the end connections shall be provided with lugs for shackling or the bells shall have sufficient clearance between the body of the valve and the hub to permit the installation of shackles. *See Standard Plan nos. 310b and 311b for additional hydrant valve requirements.*

7-14.3(3) RESETTING EXISTING HYDRANTS

Resetting hydrants, or moving an existing hydrant closer to or farther away from a Water Main on an existing hydrant connection, will be performed by SPU Water Operations.

When the Contract specifies the resetting of an existing hydrant, the hydrant shall be reset without disturbing the location of the hydrant lateral tee at the Water Main.

The hydrant shall be shackled as specified in Section 7-14.3(2)B.

This work shall be in accordance *with Section 7-14.3(1)*.

7-14.3(4) *RELOCATING EXISTING HYDRANTS*

Relocating hydrants, or moving an existing hydrant and connection pipe to a new location, will be done by SPU Water Operations crews.

7-14.3(5) RESERVED

7-14.3(6) HYDRANT BARREL EXTENSIONS

The minimum requirements for hydrant barrel extensions, operating stems, and flanged adapters shall conform to AWWA C502 in design, Material, and workmanship. The drilling of the flanges on the extensions shall match the drilling of the flanges on the hydrant.

7-14.3(7) RESERVED

7-14.3(8) RESERVED

7-14.3(9) RETAINING WALLS FOR HYDRANTS

Where indicated on the Drawings, the Contractor shall furnish and place a broken concrete slab wall around hydrants in accordance with Standard Plan no. 313 and Section 8-15.3(5)A. The broken concrete slabs shall be a minimum of 3-1/2 inches in thickness and not less than 3 feet x 1.5 feet in size. The slabs shall be set in level layers of the same thickness, and the exposed faces shall be as smooth as the shape and size of the slabs permit. The backfill behind the wall shall be Mineral Aggregate Type 2, in accordance with Section 9-03.

Rock facing rock may be used in place of broken concrete slab (see Standard Plan no. 141 and Section 2-08.3(5)). The depth of keyway shall be as shown in Standard Plan no. 141.

Ecology blocks may also be used in place of broken concrete slab. The keyway, Mineral Aggregate Type 2 filter Material, and geotextile shall be as shown in Standard Plan no. 313.

7-14.3(10) *HYDRANTS ON WATER MAINS THAT ARE POLYETHYLENE ENCASED, MULTI-LAYERED POLYETHYLENE ENCASED, OR SPECIALLY COATED*

Unless the Contract specifies otherwise, hydrants installed on special coated Water Mains, such as polyethylene encased, multi-layered polyethylene encased, thermoplastic coated, or other special pipe coating per Contract, the following shall be required:

1. *Hydrant Connections up to and not including the hydrant (See Section 7-14.3(2)) shall have the same coating as the Water Mains to which they are connected, and shall have Class B bedding in accordance with Section 7-10.3(9);*
2. *Hydrant barrels below ground shall have the same special coating as the Water Main to which they are connected with the exception of thermoplastic coating;*
3. *Hydrants connected to thermoplastic coated Water Mains shall have the hydrant barrel below ground polyethylene encased. Thermoplastic coating of the hydrant will not be allowed; and*
4. *Hydrant connection shall be installed as specified in Section 7-11.3(6).*

7-14.3(11) HYDRANT FIELD PAINTING

Following hydrant installation and prior to backfill, any damaged coating on the below-ground portion of the hydrant shall be repaired with the same coating as recommended by the coating manufacturer and approved by the Engineer. Painted hydrants with damaged paint coating shall be painted with Asphaltic Varnish, Royston Roskote number 612XM, or approved equal.

After shear pad construction or final surface restoration, the hydrant curb stand section including all exposed surfaces of the sidewalk flange shall receive two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approved equal) in Caterpillar yellow. Based on the elevation of the hydrant within the surrounding pressure zone, if the maximum static pressure at the hydrant is less than 60 psi, the engine port cap on the hydrant shall be painted with two coats of oil based gloss enamel paint (Kelly-Moore Luxlite or approved equal) *as indicated by the notes on Standard Plan nos. 310a and 311a.*

7-14.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for rock facing and for ecology block hydrant walls will be in accordance with Section 2-08.4 as for the Bid item "Rock Facing".

Measurement for concrete slab hydrant wall will be in accordance with Section 8-15.4.

Measurement for hydrant and hydrant connection will be per each.

Measurement for filter material for hydrant walls will be in accordance with either Section 4-01.4 by the cubic yard, or by Section 8-15.4 for concrete slab wall.

7-14.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-14 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

*1. "**Hydrant, 6-Inch Connection (Type)",** per each.*

The Bid item price for "Hydrant, 6-Inch Connection (Type)" shall include all costs for the work required to pickup, deliver and install a Type 310 or Type 311 hydrant, and furnish and install on new Water Main (or existing Water Main with existing tee) complete including but not limited to excavation; backfill with suitable material; disposal of material; furnishing and installing auxiliary valve, valve box, restraint system and shackles, barrel extension, gravel drain, concrete blocks, bleeder, special coating, field painting, shear block, marker posts, the 6-inch ductile iron pipe connection between the hydrant and the Water Main, any hydrant marker or quick connect adapter required; and obtaining the hydrant and hydrant extension.

2. **Other payment information**.

Payment for rock facing, for ecology block hydrant walls, and for filter drainage Material will be as specified in Section 2-08.5.

Payment for concrete slab hydrant wall and for filter drainage Material will be as specified in Section 8-15.5.

All costs in connection with furnishing and installing coatings and field painting as specified in this 7-14 Specification Section shall be included in the hydrant Bid item price(s).

Payment for bedding for polyethylene encased, multi-layered polyethylene encased, or special tape coated hydrant connection pipe will be in accordance with Section 7-11.5.

All costs associated with installing and removing temporary blocking, and removing existing blocking when indicated in the Contract shall be incidental to the various Bid items and no separate or additional payment will be made therefore.

SECTION 7-15 WATER SERVICE CONNECTION TRANSFERS

7-15.1 RESERVED

7-15.2 RESERVED

7-15.3 *CONSTRUCTION REQUIREMENTS*

The Contractor shall provide the Engineer at least 10 Working Days advance notice when transfer of existing water service is required.

Service transfers may not be done until the new Water Main has been tested and accepted, and then connected.

Unless the Contract specifies otherwise, SPU Water Operations will, at no cost to the Contractor:

1. Mark the exact field locations of service taps and tees on services 2 inch and smaller. Locations of services larger than 2 inch will be identified in the Contract,
2. Make all excavations for the water service connections,
3. Furnish and compact backfill including furnishing and placing temporary pavement patch.

The Contractor shall not remove or abandon existing pipe until either all existing service connections have been transferred to the new Water Main or temporary service has been provided, and the Engineer approves. The Contractor shall maintain the temporary pavement patch until completion of all work by SPU Water Operations. Adequate provisions shall be made by the Contractor during construction for the care and protection of both Water Mains and water services in use.

Actual scheduling of water service connections and related work will be addressed at the Preconstruction Conference to take into account the actual number of connections required, least inconvenience to existing water service customers, sequencing of work, and other operation and construction activity needs.

Where the Contract indicates 4 inch, 6 inch, or 8 inch service connections, the Contractor shall furnish and install tees, valves, plugs, and valve boxes. A 3 inch water service shall be considered a 4 inch water service. The tees shall be mechanical joint (MJ) x mechanical joint x flange (FLG). Valves shall be MJ x FLG, and removable plugs shall be MJ for the service connection. The MJ plugs will be returned to the Contractor after SPU Water Operations completes the service connections.

Upon completion of work by SPU Water Operations, the Contractor shall make all final adjustments of valve boxes, water meter boxes, and rings and covers to final grade at no cost to the Owner, and shall then make the final surface restorations in accordance with the Contract.

7-15.4 RESERVED

7-15.5 PAYMENT

All costs associated with water service connection transfers shall be included in the Bid item prices for the applicable Bid items and no separate or additional payment will be made.

SECTION 7-16 FLOW CONTROL SYSTEMS

7-16.1 DESCRIPTION

Section 7-16 describes work consisting of excavation, shoring, foundation preparation, bedding, jointing, backfilling and compacting for the construction of a flow control structure and detention pipe for storm water storage. The flow control structure shall consist of manhole structure with a flow control device.

Trenching and excavating for flow control systems are subject to the provisions of Section 7-17.3(1)A. Trench safety shall comply with 7-17.3(1)A7a, Trench Safety Systems.

7-16.2 MATERIALS

Materials shall meet the requirements of the following Sections:

Flow Control Structure and Pipe	9-05
Manhole Components	9-12
Non-Shrink Cement Sand Grout	*9-04.3(2)*

Joint coupling bands for detention pipe shall be of the type specified in Section 9-05.1(2)B and 9-05.1(3)B.

Corrugated metal pipe (CMP) flow control systems and detention systems will not be allowed in any landslide-prone area as defined in SMC 25.05.908.

Corrugated metal pipe flow control systems *and detention systems* which are to be owned, or to be maintained, by the City will not be allowed.

Flow control systems to be owned, or to be maintained, by the City shall be concrete.

7-16.3 CONSTRUCTION REQUIREMENTS

7-16.3(1) GENERAL

All work including excavation, foundation preparation, bedding, pipe installing and jointing, and backfilling for the construction of detention pipe and flow control Structure shall be in accordance with Sections 7-05 and 7-17.

7-16.3(2) FLOW CONTROL STRUCTURE

The PVC orifice plate shall be fusion-welded to the PVC cross or tee with an orifice of the diameter indicated on the Drawings drilled in its center.

The PVC shear pin shall be 3/4-inch in diameter and shall be fastened with a PVC cotter pin and stainless steel washer.

One end of the shear gate chain shall be attached to the shear gate and the other end shall be attached to a galvanized anchor bolt embedded in the leveling block. The chain shall be slack when the gate is closed.

After pipes have been placed in their final positions, openings in the walls of the flow control structure shall be grouted in place to present a smooth, flush *with* inner and outer surfaces *of walls.*

7-16.3(3) DETENTION PIPE

Seams in pipes and bands shall be gasketed in accordance with AASHTO M 196.

The end plate shall be welded to the end of the detention pipe with a watertight continuous weld.

The end of the detention pipe inside the flow control structure shall be ground smooth of all burrs and sharp edges.

Aluminum which is to be in contact with a Portland cement product (Controlled Density Fill, concrete, grout, mortar, *and other similar products)* shall first be cleaned with a solvent to remove contaminants. The cleaned surface shall then be painted with two coats of paint as specified in Section 9-05.20. The aluminum surface treatment shall extend a minimum of two feet beyond the surface to be in contact with the Portland cement product.

Bedding for the detention pipe shall be Class B, using Mineral Aggregate Type 22 as *indicated on the Drawings.*

Coupling bands for steel detention pipes shall be Type “D” per WSDOT Standard Plan no. B-13a.

7-16.3(4) TEE CONNECTION TO CORRUGATED PIPE

Drainage pipes connected to corrugated detention pipe shall be made through a shop fabricated tee as shown on the Drawings and shall be installed in accordance to Section 7-17.3(2)C2. Tee shall be made to conform to size of detention pipe and sized to accept only rubber joint pipe.

7-16.3(5) TESTING

Testing of flow control systems for leakage shall be in accordance with Section 7-17.3(4)B.

All detention systems shall be tested in accordance with Section 7-17.3(4)B. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of proposed testing.

7-16.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Flow Control Structure, (Diameter)" will be by each Structure complete in place.

Measurement for the "Pipe, Detention, (Material) (Size)" will be by linear foot for the actual length of pipe installed from inside face of flow control Structure to end plate. No separate or additional measurement will be made for the air vent when applicable.

Measurement for outlet pipe will be in accordance with Section 7-08.4.

Measurement for trench safety systems will be in accordance with Section 7-17.4.

7-16.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-16 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Flow Control Structure, (Diameter)",** each.

The Bid item price for "Flow Control Structure, (Diameter)" shall include all costs for the work required to furnish and construct the flow control Structure and internal appurtenance complete in-place including excavation, backfill and compaction with suitable native material, gravel bedding or foundation Material, making the connection with outlet pipe, and flexible adapter coupling.

2. "**Pipe, Detention, (Material), (Size)",** per linear foot.

The Bid item price for "Pipe, Detention, (Material), (Size)" shall include all costs for the work required to furnish, install, and test for leakage the detention pipe and end plate, grinding smooth the end of the detention pipe in the flow control structure, cleaning and painting the aluminum or steel surfaces as specified and all applicable work listed for the Bid item "Pipe, (Use), (Material), (Class), (Size)" of Section 7-17.5.

If an air vent is required by the Contract, all costs for fabricating and installing it shall be included in the Bid item price Bid for "Pipe, Detention, (Material), (Size)" And no separate or additional payment will be made.

3. **Other payment information**.

The outlet pipe of the flow control structure will be paid as "Pipe, Catch Basin Connection (Material), (Class), (Size)" per Section 7-08.5.

Tees required outside the flow control Structure will be paid as specified in Section 7-17.5.

Payment for trench safety systems will be as specified in Section 7-17.5.

SECTION 7-17 STORM DRAINS AND SANITARY SEWERS

7-17.1 DESCRIPTION

Section 7-17 describes work consisting of trench excavation, protective systems, foundation preparation, bedding, cut-in tees, pipe installing, jointing, backfilling, compacting and testing for the construction of Storm Drain, and sanitary and combined Sewer.

All reference to "Sewer" in Specification Section 7-17 shall apply equally to construction of sanitary Sewer, combined Sewer, and Storm Drain. Side Sewer is addressed in Section 7-18.

7-17.2 MATERIALS

7-17.2(1) GENERAL

Pipe *Material* used for sanitary Sewers, combined Sewers, and Storm Drains will be specified on the Drawings and may be one or more of the following:

Flexible Pipe Material	***Rigid Pipe Material***
Polyvinyl Chloride (PVC)	All Concrete
Acrylonitrile butadiene styrene (ABS)	Ductile Iron
Corrugated Metal	Vitrified Clay
Spiral Rib	
Polyethylene (PE)	

Aluminum or steel corrugated pipe may be used for storm drains when specified in the Contract.

Pipe shall have flexible gasketed joints unless otherwise specified *in the Contract*.

It is not intended that Materials listed be considered equal or generally interchangeable for all applications. *The Engineer will determine from the Materials listed, those that are suitable for the Project and will so specify in the Contract*.

Materials shall meet the requirements of the following sections:

Joint Materials and Non-Shrink Cement Sand Grout	9-04
Pipe	9-05
Controlled Density Fill (CDF) - Pipe Bedding & Trench Backfill	*9-01.5*

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and thickness. Lettering shall be legible and permanent under normal conditions of handling and storage. Concrete pipe with elliptical reinforcement shall be clearly marked on the inside and outside of the pipe along the minor axis to identify top and bottom.

After installation, pipe shall be tested for leakage in accordance with Section 7-17.3(4).

7-17.2(2) PROOF TESTS (PREQUALIFICATION)

The intent of this requirement is to pre-qualify a joint system, components of which meet the above requirements, as to the water tightness of that joint system. This proof test shall apply to all pipes which are to be tested for water tightness prior to acceptance. Materials and test Equipment for proof testing shall be provided by the manufacturer. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester. Proof Tests shall meet the requirements of the following Sections:

Joints	9-04
Pipe	9-05

7-17.2(3) MATERIAL CERTIFICATION

The manufacturer or fabricator shall furnish a Manufacturer's Certificate of Compliance, based on manufacturer's routine quality control tests, that the pipe meets or exceeds the requirements of the pertinent ASTM or ANSI specification.

7-17.3 CONSTRUCTION REQUIREMENTS

7-17.3(1) EXCAVATION AND PREPARATION OF TRENCH, AND PIPE BEDDING

7-17.3(1)A TRENCH EXCAVATION

7-17.3(1)A1 GENERAL EXCAVATION REQUIREMENTS

All open excavations including trenches shall comply with the requirements of WAC Chapter 296-155.

The length of trench excavation in advance of pipe installation shall be kept to a minimum and in no case shall exceed 150 feet.

Sidewalk, pavement, appurtenant structure, adjacent improvement and underground installation shall not be undermined or disturbed.

The maximum trench width between the bottom of excavation and the top of the pipe shall be in accordance with Standard Plan no. 284. If the maximum trench width is exceeded without written authorization of the Engineer, the Contractor as directed by the Engineer shall provide pipe of higher strength classification and shall provide a higher class of bedding.

Trench width above the top of pipe in the Right Of Way within paved Roadway, sidewalk, or other improved area and where near to structure or underground installation or other improvement, shall not exceed the maximum *neatline* trench width as indicated on Standard Plan no. 284. Outside the Right Of Way and in unimproved areas, trench width above the top of pipe may at the Contractor's option exceed the maximum trench width indicated on Standard Plan no. 284 by sloping or benching. *However, all requirements for excavating, handling and disposing of excavated material, and placing and compacting replacement suitable backfill, outside of Standard Plan no. 284 neatline trench limits shall be at the Contractor's sole expense.*

All ledgerock, boulders, stones, and any other object larger than 3 inch in any dimension shall be removed where within 6 inches in any direction from the pipe. The maximum size of aggregate within 6 inch of the pipe shall not exceed 1 inch per foot of pipe diameter and in no case shall exceed 3 inch.

Prior to installation of bedding and pipe, the trench bottom shall be brought to grade as indicated in the Contract for the type of bedding specified and if the trench bottom is disturbed, compacted to 90% as specified in Section 2-03.3(14)E for a one (1) foot depth to provide a foundation capable of supporting the pipe in its proper position. Bedding and backfill Material shall be placed as indicated on Standard Plan nos. 285 and 284. Where Class D bedding is specified in the Contract, additional trench bottom preparation shall comply with Section 7-17.3(1)B.

Excavation for manholes and other Structures connected to the *pipelines* shall be sufficient to provide a minimum of 12 inches between the side surface of the Structure and the sides of the excavation.

All material excavated from trenches and piled adjacent to the trench shall be piled and maintained so that the toe of the slope is at least 2 feet from the edge of the trench. This material shall be piled to cause a minimum of inconvenience to public travel, and provision shall be made for *Traffic* where necessary. Clear access shall be provided to all fire hydrants, water valves, and *water* meters. Surface drainage and runoff along gutters to storm drain facilities and along natural watercourses shall not be blocked. See Section 1-07 for other requirements.

The Contractor shall remove any support system or shield system or related system in such a manner as to not disturb bedding or backfill. Where bedding or backfill is disturbed, the Contractor shall reconsolidate these materials to specified requirements.

7-17.3(1)A2 EXTRA EXCAVATION

When, after excavating to the specified foundation level, if the material remaining in the trench bottom is determined unsuitable by the Engineer, then excavation shall be continued to such additional depth as directed by the Engineer.

All additional excavation directed by the Engineer or indicated in Contract which is beyond neatline limits indicated on Standard Plan nos. 284 and 285 will be considered "Extra Excavation".

Where foundation Material is required, it shall consist of Mineral Aggregate Type 2, unless the Contract or Engineer specifies otherwise.

7-17.3(1)A3 DEWATERING

During excavation, installation of pipeline, and placement of bedding and trench backfill, excavations shall be kept free of water. The Contractor shall control surface run-off so as to prevent entry or collection of water in excavations. The static water level within the excavation shall be drawn down a minimum of 1 foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow acceptable placement of any bedding or backfill to the required density.

At least 10 Working Days before dewatering is started, the Contractor shall submit to the Engineer, the method and installation including details of the dewatering system and groundwater recharge system as necessary, indicating number and type of equipment and pipelines including capacity(ies), dewatering pits and locations, water discharge locations, groundwater recharge locations and means of recharging the groundwater table where necessary, groundwater monitoring systems where necessary, an estimate of advance time to dewater the trench prior to work in the trench when necessary, filter systems and locations as necessary, and such other information to verify acceptable control and performance. Open and cased sumps shall not be used as primary dewatering for excavations deeper than 3 feet below the static water table.

The Contractor shall furnish, install, and operate all necessary Equipment to keep excavations free from water during construction. The control of groundwater shall prevent softening of the bottom of excavations, or formations of "quick" or heaving conditions, or "boils". Dewatering systems shall be designed and operated so as to prevent any removal or flowing of native soils. Disposal of the water shall not cause injury to public or private property, or nuisance to the public. Sufficient pumping and power Equipment in good working condition shall be available at all times for all emergencies, including power outage, and competent workmen shall be available at all times for the operation of the dewatering and recharge system.

The dewatering system shall be designed to prevent loss of foundation support to adjacent structure, underground installation, improvement, or the sides of an excavation, and may require recharging the groundwater outside the excavation.

The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not drawn down to the extent that would damage or endanger adjacent structure, underground installation, sidewalk, pavement, other improvement, or property.

The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils and supported soils, prevent disturbance of compacted bedding and backfill, and prevent flotation or movement of Structures, pipelines, Sewers, and storm drains.

All costs associated with dewatering the trench excavation and controlling groundwater shall be included in the various Bid Items and no separate or additional payment will be made therefore, unless the Contract specifies otherwise.

The Contractor is fully responsible for controlling groundwater.

7-17.3(1)A4 UNEXPECTED OBJECTS

Unexpected objects, such as stumps, railroad ties, buried pavement, etc., encountered in the trench excavation shall be removed and disposed of by the Contractor. Removal of unexpected objects will be considered incidental to pipe installation unless one or more of the following conditions are met:

1. The object(s) cannot be removed by the Equipment or excavation method at hand; or
2. The trench width or depth must be increased by 2 feet or more.

In the event the Contractor meets condition 1 or condition 2 or both conditions listed immediately above, removal of the object will be paid in accordance with Section 1-09.4.

7-17.3(1)A5 TRENCH EXCAVATION IN SOLID ROCK

Solid Rock Excavation shall cover the removal and disposal of solid rock as defined in Section 2-03.1(2).

Materials removed shall be replaced with suitable excess excavated native Materials from adjacent trenches or Roadway excavations, or from imported Mineral Aggregate *Type* or selected Material as specified by the Engineer.

7-17.3(1)A6 SURPLUS MATERIAL

Surplus Material obtained from trench excavation and determined to be suitable Material for use elsewhere on the Project Site by the Engineer shall be used as selected Material in accordance with Section 2-03.3(10).

Surplus Material obtained from trench excavation and not needed elsewhere on the Project shall be disposed of in accordance with Section 2-01.2.

Unsuitable Material obtained from trench excavation shall be disposed of in accordance with Section 2-01.2.

7-17.3(1)A7 PROTECTIVE SYSTEMS

7-17.3(1)A7a TRENCH SAFETY SYSTEMS

Where trench excavation is deeper than 4 feet, the Contractor shall construct and maintain safety systems that meet the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17) including compliance with WAC Chapter 296-155. Ditches, channels, and similar earth openings over 4 feet in depth may be considered trench excavation over 4 feet deep and may be subject to the requirements of the Washington Industrial Safety and Health Act (RCW Chapter 49.17, including WAC Chapter 296-155).

Protective systems for use in excavations more than 20 feet in depth shall be designed by a registered professional engineer (see Section 1-05.3(2)F).

The Contractor's trench safety system shall be a protective system designed and maintained by a competent person and shall meet accepted engineering requirements or practices. This trench safety system may require the use of a support system in locations not designated in the Contract as requiring a support system.

The trench safety system shall protect the Work, existing property, utilities, underground installation, pavement, improvement, etc., and shall provide safe working conditions in the trench. The Contractor may use a shield system; however, all Work required by the Engineer outside neatline trench width indicated on Standard Plan no. 284 including but not limited to:

1) handling and disposal of excavated material;
2) additional backfill beyond neatline trench limits;
3) additional surface restoration beyond limits indicated in the Contract; and/or
4) repair of damage to adjacent structure, improvement, or underground installation,

caused by the Contractor's operations shall be at the sole expense of the Contractor and at no additional or separate cost to the Owner.

The Contractor shall control water to protect employees from potential hazards posed by water.

The protective system shall be removed from the trench, once the work in the excavation is complete, in a manner which provides an acceptable means of reconsolidating the bedding, backfill, or side support Material without disturbance to the pipe.

The use of horizontal strutting below the pipe barrel or the use of the pipe as support for trench bracing will not be permitted.

7-17.3(1)A7b SUPPORT SYSTEM

In addition to worker safety requirements specified in Section 7-17.3(1)A7a, where trench excavations are to be laterally supported as required in the Contract at locations indicated on the Drawings, the lateral support shall be a support system as defined in WAC 296-155-650. Support systems may consist of underpinning, bracing, shoring, sheeting, or any other protective system or combination of protective systems which provides support to an adjacent structure, underground installation, and the sides of an excavation. The support system shall also include the control of groundwater as specified in Section 7-17.3(1)A3. The Contractor shall employ methods of installing, maintaining, and removing the system causing the least disturbance. During installation of the system, and when the system is installed, the Contractor shall fill all voids behind the support system as necessary and when necessary to prevent loss of native soils or loss of soil support. When removing the support system, the Contractor shall coordinate reconsolidation of bedding as necessary, and with backfilling to minimize disturbance.

All costs for this work will be paid by the Bid item "Support System".

The Contractor shall submit Shop Drawings and design calculations, in accordance with Section 1-05.3(2)F, of the proposed support system including loading calculations, structural member and system calculations, and sufficient details of installation, maintenance, and removal concurrent with excavation, installation, removal, and backfilling.

7-17.3(1)B PIPE BEDDING

7-17.3(1)B1 GENERAL

Bedding, of the class or classes shown on the Drawings, shall be installed in accordance with Standard Plan no. 285, and shall include all the Materials and work within the limits of the bedding zones indicated on Standard Plan no. 285.

Unless otherwise specified in the Contract, bedding for rigid and flexible pipe shall be Class B except bedding for ductile iron pipe shall be Class D.

All classes of bedding shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bell holes shall be excavated as required to ensure uniform support along the pipe barrel. Bedding disturbed by pipe movement or by removal of shoring or movement of a trench shield or box shall be reconsolidated prior to backfill. Special care shall be taken to provide adequate bedding support at wye or tee connections and adjacent to manholes or other Structures, so as to avoid bending or shearing stresses at these critical points.

7-17.3(1)B2 BEDDING FOR RIGID PIPE

Bedding shall be classified as Class A, Class B, Class C and Class D. The requirements and limits for the various classes of bedding are as shown on Standard Plan no. 285 and *are described as follows*:

1. **Class A Bedding**: Concrete for Class A bedding shall be Class 4 (1 ½) (*see Section 5-05.3)* and shall be a 4 sack minimum Portland cement *concrete mix with* 1 ½ inch *maximum size* aggregate. When placing the concrete bedding, the pipe shall be prevented from floating. Concrete shall be allowed to cure for a minimum of 12 hours prior to placing the Type 9 Mineral Aggregate bedding Material. Mineral Aggregate bedding shall then be placed in lifts of not more than 6 inches to a point 6 inches above the top of the pipe. Compaction of Mineral Aggregate Type 9 shall be to 90% *as specified in Section 2-03.3(14)E. Before beginning work on concrete bedding, the Contractor shall submit a mix design for 1-1/2 inch maximum size aggregate concrete with a 28 day strength of 4,000 psi to the Engineer for approval at least 5 Working Days in advance.* It shall have a sufficiently fluid consistency to readily fill all voids around and under the pipe.
2. **Class B Bedding**: Class B bedding of Type 9 Mineral Aggregate shall be placed in at least three lifts. The first lift shall be placed before the pipe is installed and shall be a minimum of 4 to 6 inches in thickness (see dimension "A" on Standard Plan no. 285). The Material shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches shall be brought up to a

point 6 inches above the top of the pipe. Each lift shall be brought up on both sides of the pipe and shall be carefully worked under the pipe haunches by means of slicing with a shovel, vibration, or other procedures approved by the Engineer. Compaction of bedding shall be to 90% maximum dry density as determined by *methods specified in Section 2-03.3(14)E.*

3. **Class C Bedding**: Requirements for Class C bedding shall be the same as for Class B except that the Type 9 Mineral Aggregate shall extend only to the springline of the pipe. Selected native Material shall then be placed in 6 inch lifts to 6 inches above the pipe, using the same methods as those required for Class B bedding. Compaction of Mineral Aggregate Type 9 shall be to 90% maximum dry density as determined by *methods specified in Section 2-03.3(14)E*. Compaction of native Material shall be as specified in Section 7-17.3(3).

4. **Class D Bedding**: Class D bedding shall be attained by carefully excavating the trench to proper grade, overexcavating at the bell sections, and placing and compacting selected Material around the pipe. Class D bedding and backfill shall be in accordance with Section 7-17.3(3).

Where unauthorized excavation has been made below the established grade, the Contractor shall provide, place, and compact suitable bedding Material to the proper grade and elevation. If the Engineer substitutes imported a Mineral Aggregate Type in lieu of the selected native Material shown for Class C and for Class D bedding on Standard Plan no. 285, the bedding will be measured and paid for as "Bedding, Class B, (Size) Pipe".

7-17.3(1)B3 BEDDING FOR FLEXIBLE PIPE

All references to this Specification Section regarding Water Main trench excavation shall make reference to Standard Plan no. 350 unless specified otherwise in the Contract, and any Water Main reference to Standard Plan nos. 284 and/or 285 shall be interpreted as reference to Standard Plan no. 350 unless the Contract specifies otherwise.

Bedding for flexible pipe shall be Class B bedding with Mineral Aggregate Type 22 placed in several lifts in accordance with Standard Plan no. 285. Before installing the pipe, a first bedding lift of 4 or 6 inch thickness, depending on pipe size, shall be placed. Then the pipe is installed. The bedding shall be spread smoothly so that the pipe is uniformly supported along the barrel. Subsequent lifts of not more than 6 inches thickness shall be installed to the crown of the pipe and individually compacted to 90% density as *determined in Section 2-03.3(14)E*. A further 6 inch lift of moderately compacted Material shall be placed over the crown of the pipe in a manner not to crush or disturb the pipe.

7-17.3(2) INSTALLING SEWER PIPE

7-17.3(2)A SURVEY LINE AND GRADE

The Contractor may use any method, such as "swede line and batter board", "laser beam", etc., which would allow accurate transfer of the control points provided by the Engineer to installing the pipe to the designated alignment and grade.

When using the "swede line and batter board" method, the Contractor shall transfer line and grade into the trench where they shall be carried by means of a taut grade line supported on firmly set batter boards at intervals of not more than 30 feet. Not less than three batter boards shall be in use at one time. Grades shall be constantly checked and in the event the batter boards do not line up, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

When using a laser beam to set pipe alignment and grade, the Contractor shall constantly check position of laser beam from surface hubs provided by the *Engineer* to *verify* laser beam alignment and grade. In the event the laser beam is found out of position, the Contractor shall stop work and make necessary corrections to the laser beam Equipment and to pipe installed.

7-17.3(2)B PIPE INSTALLATION AND JOINTING

7-17.3(2)B1 PIPE INSTALLATION

After an accurate grade line has been established, the pipe shall be installed within reasonably close conformity to the established line and grade in the properly dewatered trench. Mud, silt, gravel, and other foreign Material shall be kept out of the pipe and off the jointing surfaces.

All pipe installed in the trench to the specified line and grade shall be kept in longitudinal compression until the bedding has been placed and compacted around and over the pipe. All pipe shall be installed to conform to the prescribed line and grade shown *in the Contract*.

Pipe shall be installed to a true line and grade at the invert of the pipe. The Contractor shall exercise care in matching pipe joints for concentricity and compatibility. In no case shall two pipes be joined together with ends exceeding the maximum manufacturer's tolerance. The limit of variance at the invert shall not exceed plus or minus 0.03 foot from true line and grade at the time of backfill, and in no case shall result in reverse flow or have a sag. Checking of the invert elevation of the pipe may be made by calculations from measurements on the top of the pipe.

The pipe shall be installed in the up-grade direction from the point of connection with the existing pipe, or from a designated Structure as a starting point. The pipe shall be installed with the bell end forward or upgrade. When pipe installation is not in progress, the forward end of the pipe shall be kept tightly closed with an approved temporary watertight plug.

7-17.3(2)B2 JOINTS – HAND MORTARED AND ON CURVES

Where pipelines are to be installed on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the pipe manufacturer, the curves shall be achieved with a series of tangents and

shop-fabricated bends complying with the pipe manufacturer's recommendations as approved by the Engineer. The Contractor shall submit the pipe manufacturer's recommendations for approval at least 5 Working Days in advance. Pipe invert shall comply with the requirements of Section 7-17.3(2)A.

Hand mortared pipe joints will not be allowed. All joints shall be water tight and meet the applicable test requirement(s) of Section 7-17.3(4).

See Section 7-17.3(2)E for gasketed jointing.

7-17.3(2)C PLUGS AND CONNECTIONS

7-17.3(2)C1 GENERAL

All fittings shall be capped or plugged with a plug of an approved Material gasketed with the same gasket Material as the pipe unit; or shall be fitted with an approved mechanical stopper; or shall have an integrally cast knock-out plug. The plug shall be able to withstand all test pressures without leaking, and when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

Should testing or television inspection indicate installed pipe is damaged or does not pass testing, the Contractor shall remove and replace the failed or damaged section of pipe. Should the Contractor believe the pipe which is damaged, or which failed the test, can be repaired by other than remove and replace, the Contractor shall submit a repair method for approval by the Engineer at least 5 Working Days in advance. The replaced, or repaired pipe, shall again be inspected and tested. Repairs using rubber boot type methods, such as FERNCO type coupler repairs, will not be allowed. See Section 7-17.3(4).

7-17.3(2)C2 FITTINGS

Unless otherwise specified in the Contract, tee fittings shall be provided in the Sewer and Storm Drains for side Sewers, catch basin connections and service drains. Tees shall be 8 inches inside diameter, except tees for side Sewers shall be 6 inches inside diameter unless indicated otherwise in the Contract. All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same Materials as the pipe, except when core drilling to insert a tee, which shall be per Section 7-17.3(2)C3. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. *Fittings shall make for a water tight connection meeting the requirement(s) of Section 7-17.3(4).*

All tees on new pipe less than 24 inch inside diameter shall be prefabricated.

7-17.3(2)C3 CUT-IN TEE ON EXISTING OR NEW PIPE

Unless the Contract indicates otherwise, the Contractor shall locate and cut a hole in the existing or new pipe for a springline to springline connection, and the tee shall be installed into the pipe at a 45 degree angle to the horizontal. Coring shall be done such that the cored out piece or other materials do not drop into the pipe. The Contractor shall notify the Engineer at least 2 Working Days in advance of cut-in tee operation.

Coring shall be performed in accordance with the following:

1. **Concrete Pipe Tee To Concrete Pipe**: Installing tee on Concrete Pipe shall be accomplished by core drilling a full size hole in one operation to accommodate an approved PVC tee insert with a coupling fitting, or a saddle type tee manufactured for the size of pipe on which the tee is being installed. *A concrete tee may be installed on an existing concrete pipe 18 inches in diameter or larger by placing a short length of concrete pipe into the core-drilled hole with its bell end against the outside face of the pipe and the barrel end inserted just to the inside face of the pipe*. The Contractor shall thoroughly clean the bonding areas between the tee and the pipe so that the surfaces are free of dirt, dust, grease, oil or other contaminants that may reduce the bond between the grout and the pipe surfaces. *Both surfaces shall first be coated with a concrete bonding agent submitted for review and accepted by the Engineer*. The annular space between the tee and the core-drilled surfaces shall then be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.
2. **Ductile Iron Tee To Existing Concrete Pipe**: The existing concrete pipe shall be core-drilled with a hole large enough to accommodate the barrel of the specified size of ductile iron pipe and provide a 1-inch space between *ductile iron pipe* and the existing *concrete* pipe for application of grout. A length of ductile iron pipe shall be cut so that it can be placed in the core-drilled hole with its bell end against the outside *face* of the existing pipe without the barrel protruding beyond the inside face of the existing pipe. The Contractor shall clean the outside of the ductile iron pipe, removing loose particles (dust, dirt, oil, or film of any sort) that may reduce the bond between the grout and the pipe. After core drilling, the exposed surface of the existing concrete pipe shall be rough and clean. Both surfaces shall be coated with a bonding agent *submitted for review and approved* by the Engineer. The annular space between the pipe and core drilled surfaces shall be tightly packed with non-shrink cement sand grout meeting the requirements of Section 9-04.3(2). The connection shall be neatly finished inside and outside the existing concrete pipe.
3. **Saddle-Type Tee to Ductile Iron Pipe**: The ductile iron pipe shall have a full-sized hole cut into it by core drilling or by the arc-weld flame cutting method. The Contractor shall obtain approval of the method from the Engineer at least 2 Working Days in advance. *A saddle-type tapping tee, manufactured to fit the receiving pipe, shall be mounted after the contact area between tee and pipe has been cleaned of all dirt, sand, grit, grease and other foreign matter to ensure continuous contact by the straps.*

4. **Corrugated Metal Tee To Corrugated Metal Pipe**: In corrugated steel and aluminum pipes, a hole shall be sawcut to match a shop fabricated tee as indicated in Standard Plan no. 279.

The flange plate of the fabricated tee shall be corrugated to match corrugation of the pipe to which it is attached. A neoprene gasket or approved equal shall be inserted between the outside face of the existing pipe and the flange plate of the tee and connected by bolting. Corrosion protection shall be provided if the pipe section of the tee is non-corrugated aluminum pipe.

The incoming pipe and the tee shall be connected with stainless steel rigid walled flexible coupling. If the pipe section of the tee is aluminum, corrosion protection shall be provided by isolating the aluminum from the steel by extending the gasket 1 inch beyond the edge of the stainless steel coupling.

5. **Inserta Tee To Clay Pipe**: The Contractor shall submit the method and type tee recommended by the tee manufacturer to the Engineer for approval at least 5 Working Days in advance.

All existing small diameter pipe made of non-reinforced concrete or vitrified clay shall be fully exposed for inspection.

The excavation shall be backfilled and compacted per Section 7-17.3(3).

The Contractor shall notify the Engineer at least *2 Working Days* before beginning cut-in operations (Note - The Engineer will notify Drainage and Wastewater Utility @ 206-386-1230 for the South District or 206-684-7506 for the North District). *The existing pipe shall be inspected by the Engineer for defects before the drilling or cutting operation starts, again during drilling or cutting operations, and after installation of the tee is completed to make certain that no defective parts or work remain undetected and uncorrected. If the Contractor has requested the Engineer to core drill the hole, the Contractor shall provide a tee made of the same Material and with the same corrugations as the cored pipe*.

If the exposed pipe is found cracked or deformed, the Engineer will arrange for either roll in of a new pipe, or repair of the damage at no cost to the Contractor, provided the damage was not caused by the Contractor's operations. If the Engineer rolls in a new pipe with a tee already on it, no fitting will be required.

7-17.3(2)D PIPE MARKINGS

On elliptically reinforced concrete pipe, the markings indicating the minor axis of the reinforcement shall be placed in a vertical plane (top or bottom) when the pipe is installed.

7-17.3(2)E GASKETED JOINTS

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or contaminating it with dirt or other foreign Material. Any gaskets so disturbed shall be removed, cleaned, replaced, and relubricated before joining the sections.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling, or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since most gasketed joints tend to creep apart when the end pipe is deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to ensure that it is home, as described in the standard installation instructions provided by the pipe manufacturer. Sufficient restraint shall be applied to the line to ensure that joints once home are held so, until fill Material under and alongside the pipe has been sufficiently compacted. At the end of the *work* Day, the last pipe shall be blocked in an effective way to prevent creep.

Where pipe must be deflected to accommodate required horizontal or vertical curvature, it shall first be joined in straight alignment and then deflected as required. *See Section 7-17.3(2)B2 for hand mortar joints and joints on curved pipe.*

7-17.3(2)F *JOINTING – BREAK-OUT AND RECONNECT & MISMATCHED WALL THICKNESS*

Where it is necessary to break out or connect to an existing pipe during construction, only new pipe having the same inside diameter shall be used in reconnecting the pipeline. Inverts, grade, and alignments are to match, as applicable. Where joints must be made between pipes with a mismatched wall thickness, the Contractor shall use a flexible gasketed coupling, adapter or coupling-adapter to make a watertight joint. Couplings shall be those manufactured by "Romac", "Smith-Blair", or approved equal. Fernco-type couplers shall not be used unless approved by the Engineer.

7-17.3(2)G *STORM DRAIN AND SEWER* CONNECTIONS

Catch basin, service drain, or side Sewer connections to Sewer and Storm Drain trunks, mains, or laterals, shall be left uncovered until after the Engineer has inspected and approved the work. After approval of the connection, the bedding and trench backfill work shall be completed.

7-17.3(2)H *SIDE SEWER CONNECTION – OVERSIZED AND CLEARANCE REQUIREMENTS*

Where a side Sewer is as large as or larger than the trunk, main, or lateral Sewer or Storm Drain to which it is to be connected, the connection shall be made only at a manhole unless otherwise provided in the Contract. The capacity of the proposed connection and capacity of existing trunk, main, or lateral Sewer or Storm Drain shall be verified and submitted to the Engineer for approval at least 15 Working Days in advance.

Side Sewers shall be installed below Water Main and shall meet the clearance requirements indicated on Standard Plan no. 286 and specified in Section 1-07.17(2).

7-17.3(2)I PROTECTION OF EXISTING SEWER FACILITIES

All existing live Sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing Sewer is damaged.

Water accumulating during construction shall be removed from the new pipeline but shall not be permitted to enter the existing system. The Contractor shall be responsible for flushing out and cleaning any existing pipeline into which gravel, rocks, or other debris has entered as a result of his/her operations, and shall repair lift stations or other facilities damaged by his/her operations.

The physical connection to an existing manhole or pipeline shall not be made until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed and, where applicable, a pipe has been temporarily placed in the existing channel and sealed.

7-17.3(2)J UNDERGROUND CONSTRUCTION

Where indicated on the Drawings, the Contractor shall install pipe by underground construction methods including jacking, augering, tunneling, directional drilling, microtunneling, or any other trenchless technology method or use of rapid excavation machine, including installing the pipe in a casing pipe, or by any combination of these methods.

When casing pipe is required, and the size and gauge of pipe has not been specified in the Contract, the Contractor shall select the gauge and size of the casing pipe compatible with the underground construction operation. The Contractor shall take care to prevent caving ahead of the casing which would create voids outside the casing pipe. When the casing is in place, the carrier pipe shall be carefully skidded through the casing pipe and adjusted to the line and grade shown on the Drawing. The annular space between the casing and carrier pipes shall be filled with Material specified in the Contract.

Ground support in portal areas, shafts, and jacking shafts shall be designed to support adjacent structure, underground installation, the sides of excavation, and withstand all forces from jacking and other operations.

At least one designated person shall be on duty above ground whenever any employee is working underground. The Contractor shall have in place communications, hoisting equipment, emergency provisions, air quality monitoring, and ventilation equipment as necessary.

At least 20 Working Days in advance of underground construction activities, the Contractor shall submit 8 sets of Shop Drawings and all necessary calculations describing these activities, including dimensioning of shaft, jacking shaft, or portal; method of shaft excavation; method of underground construction; size of underground construction; staging and surface support; waste disposal particular to a specific underground construction; control equipment; qualifications of underground construction Contractor; a complete description of shoring including installation, maintenance, and removal; and a complete description of slurry handling and disposal system when applicable; in accordance with the requirements of Section 1-05.3(2)F. The submittal shall include the name of the designated person.

The material, procedure, and Equipment employed by the Contractor shall not relieve the Contractor of responsibilities nor waive or modify any provisions of the Contract.

7-17.3(2)K TEMPORARY SEWER BYPASS

The Contractor shall install a temporary bypass to maintain uninterrupted Sewer service on Projects calling for reconstruction of existing Sewer mains or on Projects where construction Work will interfere with sewage flow in the existing Sewer. The bypass shall be made by diverting the effluent flow at an upstream access manhole and pumping it through a separate conduit to a downstream reentry point or to an adjacent Sewer system. The pump and bypass conduit shall be of adequate size and capacity to handle the flow. The effluent level in the bypass pumping manhole shall not be allowed to rise more than 1 foot above the crown of the incoming Sewer pipe. Work shall be conducted in such a manner as to comply with the requirements of Section 1-07.

A written proposal for bypassing the remaining portion of the Sewer system and the list of all Equipment to be used for the Work shall be submitted by the Contractor to the Engineer, allowing at least 10 Working Days for review and return of comments. *The Engineer's review* shall not relieve the Contractor of *its* responsibilities or of any public liability for sewage spills under this Contract.

7-17.3(3) BACKFILLING TRENCHES

7-17.3(3)A GENERAL

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting. The Contractor shall backfill from the side of the trench to a uniform depth of 2 feet above the crown of the pipe*, including the bedding,* before starting compaction. See Section 7-17.3(3)B for Compaction Requirements.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the pipe installation, provide for the maintenance of Traffic as may be necessary, and provide for the safety of property and person.

The Contractor shall use suitable native excavated Material for trench backfill unless notified by the Engineer that the native Material is unsuitable. The Engineer will examine excavated native Material at the time of excavation to determine its suitability for use as backfill. Native Material will be considered suitable for trench backfill if it is:

1. Capable of attaining the degree of compaction specified in Section 7-17.3(3)B;
2. Within reasonable tolerance of optimum moisture content; and
3. Reasonably free of organic material, clay, frozen lumps, rocks or pavement chunks more than 6 inches in maximum dimension, or other deleterious matter.

Unsuitable backfill Material shall be removed from the *Project Site*, disposed of per Section 2-01.2, and replaced with Mineral Aggregate Type 17*, selected Material,* or such other imported Material as designated by the Engineer.

The Contractor shall take any necessary steps to protect the excavated Material from becoming contaminated with excessive moisture.

Where it is required that a blanket of selected Material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the Drawings, and shall be leveled to provide for a uniform thickness of the borrow Material. Compaction shall be required.

Pipe trenches shall be backfilled as soon as possible after the pipe installation. The Contractor shall not have more than 200 feet of trench open in which the pipeline has been completed, except by permission of the Engineer. Backfilling of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until the cement in the masonry has become thoroughly hardened.

Walking on the pipe shall not be allowed until at least 1 foot of *backfill* has been placed upon it.

7-17.3(3)B COMPACTION OF TRENCH BACKFILL

Trench backfill shall be spread in layers and be compacted by mechanical tampers of the impact type approved by the Engineer. The backfill Material shall be placed in successive layers with the first layer not to exceed 2 feet above the pipe, and the following layers not exceeding 12 inches in loose thickness, with each layer being compacted to the density specified *as follows*:

1. Improved areas such as *Street* and sidewalk areas shall be compacted to 95% of maximum dry density; or
2. Unimproved areas or landscape areas shall be compacted to 90% of maximum dry density.

Compaction control tests shall be performed as specified in Section 2-03.3(14)E.

The procedure and Equipment to be used for backfill compaction shall be demonstrated on a test section of pipeline to be *located* by the Engineer at the beginning of this work. The Contractor shall make these arrangements with the Engineer at least 2 Working Days prior to beginning this work.

The Contractor shall excavate test pits in the backfill as directed by the Engineer for the purpose of testing the backfill compaction.

If the required compaction density has not been obtained, the Contractor shall remove the backfill from the trench and recompact using heavier compaction Equipment or more passes. This process shall be repeated until the Contractor has established a procedure that provides the required field density. The Contractor will then be permitted to proceed with backfilling and compacting the remainder of the pipeline under the approved compaction procedure.

In the event routine field densities taken during the course of construction show the specified compaction of backfill is not being obtained because of changes in soil types which are identified as suitable by the Engineer, the Contractor will be required to reestablish the compaction procedure. In no case will excavation, backfill, and pipe installation operations be allowed to proceed until the specified compaction of backfill is attained. Water settling will not be allowed as a method for compaction of backfill.

7-17.3(4) CLEANING AND TESTING

7-17.3(4)A GENERAL

Pipelines and appurtenances shall be cleaned and tested, after backfilling, by the exfiltration or low pressure air method, at the Contractor's option, or by infiltration test if the ground water table is such that the Engineer may require it.

All work involved in cleaning and testing pipelines between manholes or rodding inlets as required herein shall be completed within 15 Working Days after backfilling of pipelines and Structures. Any delay shall be submitted to the Engineer well in advance and requires the written consent of the Engineer. The Contractor shall furnish all labor, Materials, tools, and Equipment necessary to make the test, clean the lines, and perform all Work incidental thereto. *The Contractor shall perform the tests in the presence of the Engineer.* Precautions shall be taken to prevent joints from drawing apart during tests. Any damage resulting from these tests shall be repaired by the Contractor. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged using test tees, or acceptable alternate, securely fastened to withstand the internal test pressure. Such test tees shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

7-17.3(4)A1 PIPE NOT PASSING TESTING

Testing of side Sewers including runoff and downspout connections shall comply with the requirements of Section 7-18.3(6).

If any pipeline installation fails to meet the requirements of the test method used, or is indicated as defective by television inspection, the Contractor shall determine the source or sources of leakage and shall replace all defective pipe. Where the Contractor believes a repair can be made without removal, the Contractor shall submit to the Engineer for approval at least 5 Working Days in advance, the proposed repair. See Section 7-17.3(2)C1 for damaged connections or failed connections or plugs. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable. Replacement or repair of defective pipe shall not commence until the Contractor has received approval of the method from the Engineer.

All lateral or side Sewer branches included in the test section shall be taken into account in computing allowable leakage.

Upon final acceptance of the Work, all Sewers, side Sewers and fittings shall be open, clean, and free draining.

7-17.3(4)B EXFILTRATION TEST

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls, provided that after filling the pipe the leakage test is completed within twenty-four hours. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28 gallons per hour ("gph") per inch inside diameter ("inch dia") per 100 linear feet ("LF") of pipe, with a hydrostatic head of 6 feet above the crown at the upper end of the test section, or above the natural groundwater table at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the lower end of the section tested does not exceed 16 feet of head above the invert, and in no case shall the length be greater than 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the test head is other than 6 feet, the measured leakage shall not exceed 0.28 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the test head to the square root of 6.

$$\text{Leakage maximum} = 0.28 \times \frac{\sqrt{H}}{\sqrt{6}} = 0.114 \times \sqrt{H}$$ where leakage is in gph/inch dia/100 LF

When the test is to be made one joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

An allowance of 0.2 gallons per hour per foot of head above invert shall be made for each manhole included in a test section.

All pipe and detention systems in, or near as *indicated in the Contract*, Environmentally Critical Areas designated geologically hazardous areas, shall require exfiltration testing. Approval will not be given unless the detention system passes this test. The Contractor shall notify the Engineer at least 5 Working Days in advance of proposed testing.

7-17.3(4)C INFILTRATION TEST

Infiltration test leakage shall not exceed 0.16 gallons per hour (gph) per inch inside diameter (inch dia) per 100 linear feet (LF) of pipe tested, when the natural groundwater head over the pipe is 2 feet or less above the crown of the pipe at the upper end of the test section. The length of pipe tested shall not exceed 700 linear feet or the distance between manholes when greater than 700 linear feet.

Where the natural groundwater head is more than 2 feet, the measured leakage shall not exceed 0.16 gph per inch inside diameter per 100 linear feet times the ratio of the square root of the natural groundwater head to the square root of 2.

$$\text{Leakage maximum} = 0.16 \times \frac{\sqrt{H}}{\sqrt{2}} = 0.114 \times \sqrt{H}$$ where leakage is in gph/inch dia/100LF.

When a suitable head of groundwater exists above the crown of the pipe and when the pipe is large enough to perform work inside it, acceptance may be based on there being no visible leakage. Where leakage is indicated, the repair methods shall be submitted in writing to the Engineer by the Contractor for approval (see Section 7-17.3(4)A1).

7-17.3(4)D AIR PRESSURE TEST FOR SEWERS CONSTRUCTED OF AIR-PERMEABLE MATERIALS

1. Pipelines may be tested with low pressure air by the pressure drop method, in lieu of water infiltration or exfiltration. The pressure drop shall be from 3-1/2 to 2-1/2 psi greater than the average back pressure of groundwater above the centerline of the pipe. At the Contractor's option, pipe may be tested without pre-wetting; however, the test allowances herein assume pre-wetted pipe.
2. The allowable rate of air loss shall be .003 cubic feet per minute (cfm) per square foot of internal pipe surface; however, the total air loss shall be not exceed 3.50 cfm.
3. The test Equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges or other instrumentation that is incorporated in the test Equipment.
4. Safety Provisions. Plugs used to close the Sewer pipe for the air test *shall* be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gauges, air piping manifolds, and valves shall be located at the top of the ground. *No person shall be permitted to enter a manhole where a plugged pipe is pressurized*. (Four pounds per square inch gauge (psig) air pressure develops a force against the plug in a 12 inch diameter pipe of approximately 450 pounds.) *Air testing apparatus shall be equipped with a pressure release device designed to relieve pressure in the pipe at a pressure recommended by the pipe manufacturer*. *The Contractor shall submit the pipe manufacturer's recommendations to the Engineer.*
5. *Pipe with inside diameter less than 36 inches may be tested from manhole to manhole or on shorter lengths at the Contractor's option*. Pipe 36 inches in diameter and over shall have all joints tested individually and consecutively along the entire line. The void volume around the joint shall be pressurized to 3.5 psi over that of the groundwater above the pipe. The Contractor shall allow the air pressure and temperature to stabilize before shutting off the air supply and start of test timing.

If a pipe joint fails to pass this pressure test or also fails a retest, it shall be repaired in a manner acceptable to the Engineer. If not repairable, the damaged pipe section shall be replaced with a new one and the joints tested as specified above.

7-17.3(4)E AIR PRESSURE TEST FOR PIPES CONSTRUCTED OF NON AIR-PERMEABLE MATERIALS

7-17.3(4)E1 GENERAL

When non air-permeable pipelines are subjected to the low pressure air test, all of the provisions of Section 7-17.3(4)D shall apply except that the pressure drop shall be from 3.5 to 3.0 psig greater than the average back pressure above the center of the pipe, and the minimum time shall be twice that computed as specified under Section 7-17.3(4)D.

7-17.3(4)E2 RECOMMENDED PROCEDURE FOR CONDUCTING ACCEPTANCE TEST BY PRESSURE DROP METHOD

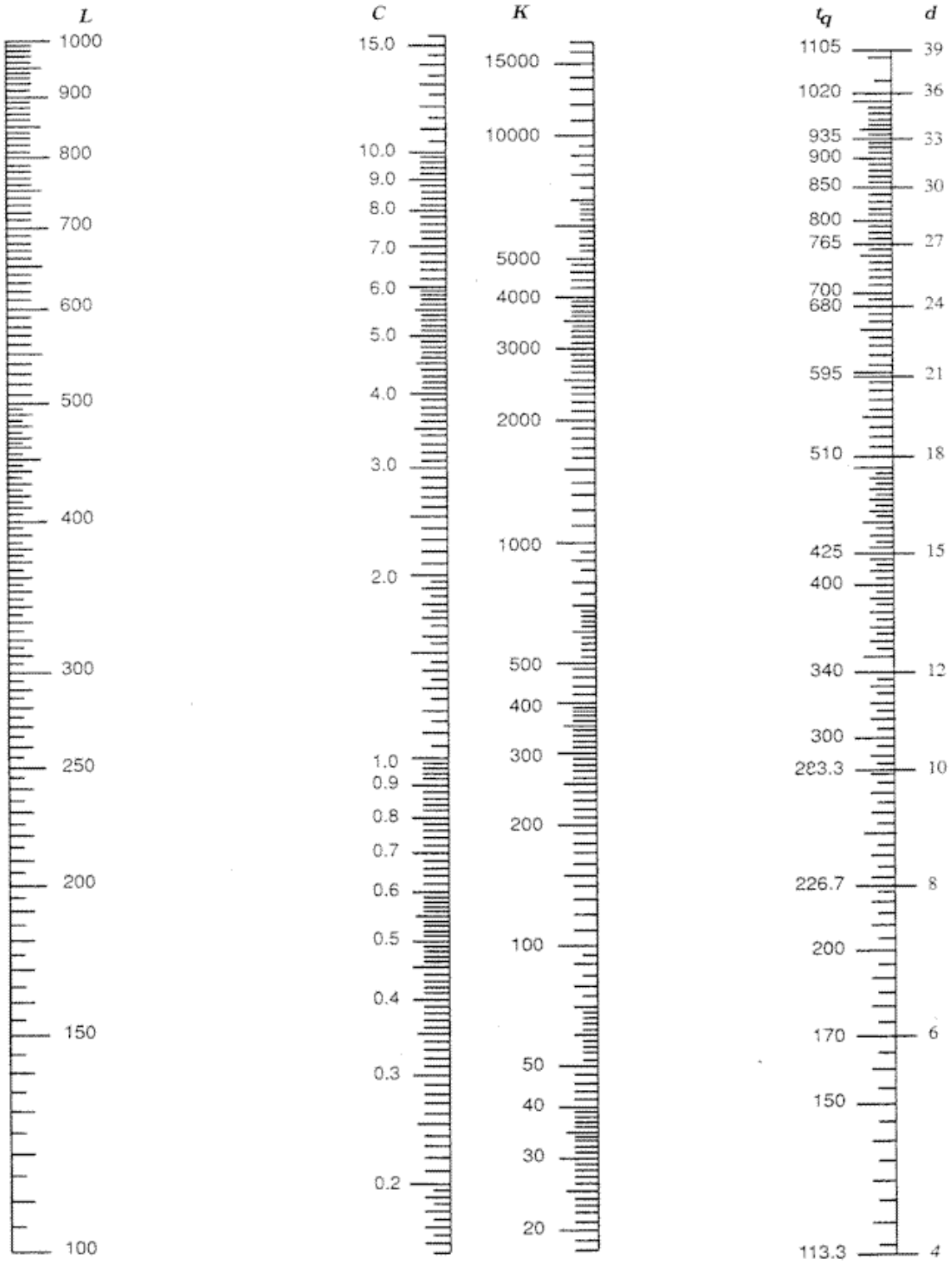
1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
2. All gauge pressures in the test should be increased by the amount of groundwater pressure at the center of the pipe.
3. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
4. After an internal pressure of 4.0 psig is obtained allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
5. After the 2 minute period, disconnect air supply.
6. When pressure has decreased to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval should then be compared with the time required *by Specification computed as follows*.
7. List size and length of all portions of pipe under test in table similar to the one that follows. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.
8. By the use of Nomograph, compute K and C. Use scales d and L, read K and C, and enter these values in the table.
9. Add all values of K and all values of C for pipe under test.
10. If the total of all C values is less than one, enter the total of all K values into the space for “Time Required by Specification”.
11. If the total of all C values is greater than one and less than 1.75, divide the total of all K values by the total of all C values to get t_q.
12. If the total of all C values is greater than 1.75, divide the total of all K values by 1.75 to get "Time Required by Specification" t_q.

Diameter Inches	Length Feet	$K = .0111d^2 L$	$C = .0003918\ dL$
		Total K _____	Total C _____
		Time required by specification (t_q) _____	

t_q = Time required by specification

d = Diameter *of pipe* in inches

L = Length of pipe in feet



NOMOGRAPH for the solution of $K = 0.011d^2L$, $C = 0.0003882dL$, $t_q = K \div C$

7-17.3(4)F HYDROSTATIC TEST FOR SANITARY SEWER FORCE MAINS

7-17.3(4)F1 GENERAL

All sanitary force mains and appurtenances shall be subjected to hydrostatic pressure testing as soon as possible after they are installed and backfilled.

The hydrostatic pressure tests shall be conducted in accordance with provisions of sections 7-17.3(4)F2 through F8.

7-17.3(4)F2 EQUIPMENT

The Contractor shall furnish the following Equipment for the hydrostatic tests:

Amount	Description
2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
	Suitable hose and suction pipe as required

Pressure gauges shall be calibrated within 6 months of hydrostatic testing. *The Contractor shall provide a Manufacturer's Certificate of Compliance stating the date of calibration of the pressure gauge to be used within 2 Working Days when requested by the Engineer.*

7-17.3(4)F3 PROCEDURE

Clean water or approved reclaimed water shall be used as the hydrostatic test fluid. All parts of the piping system shall be subjected to a minimum test pressure of 50 psi plus pressure head required to overcome pumping height.

Where any section of pipe is provided with concrete thrust blocking, do not make the pressure test until at least 5 Days have elapsed after the thrust blocking is installed. If high-early cement is used for thrust blocking, the time may be reduced to no less than 2 Days.

The Contractor shall provide all temporary plugs, caps, and thrust blocking and all closure sections and couplings required to test the pipeline in sections at the specified test pressure.

7-17.3(4)F4 DURATION

The duration of each pressure test shall be a minimum of 1 hour. A leakage test of at least 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F5 EXPELLING AIR AND FILLING PIPE

Before applying the specified test pressure, expel all air from the pipe by slowly filling the pipe with water and allow to stand for 48 hours prior to testing.

7-17.3(4)F6 PRESSURE TEST

Test pressures shall be applied by means of a pump connected to the pipe. Apply the test pressure and operate the pump as necessary to maintain the test pressure at its full value for the entire duration of the pressure test.

Before applying the specified test pressure, expel all air from the pipe by slowly filling the section of pipe to be tested with water and allow to stand for 48 hours prior to the start of testing under slight pressure. The duration of each pressure test shall be 1 hour. A leakage test of 2 hours duration shall immediately follow the pressure test.

7-17.3(4)F7 LEAKAGE TEST

For the leakage test, the pump suction shall be in a barrel or similar device or metered so that the quantity of water put into the pipeline can be accurately measured. Apply the test pressure and operate the pump as necessary to maintain the pressure in the pipeline at a minimum of 90 percent of the test pressure for the entire duration of the leakage test. At the end of the test period operate the pump until the test pressure is again attained. Leakage shall be defined as the quantity of makeup water required to maintain the pipeline pressure during the test and to restore the test pressure at the end of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{1850}$$

In the above formula:

L = Allowable leakage, in gallons per hour
N = Number of joints in the length of pipe tested
D = Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch Gauge

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)F8 CORRECTION OF EXCESSIVE LEAKAGE

Should any test of pipe disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage from subsequent testing is within the specified allowance. The Contractor shall submit the method of repair to the Engineer for approval at least 3 Working Days in advance.

7-17.3(4)G *PLUGGING EXISTING PIPE*

Where indicated on the Drawings, existing pipes shall be plugged on the inlet end as specified in Section 2-02.3(5).

7-17.3(4)H DEFLECTION TEST FOR FLEXIBLE PIPE

For pipes nominally 24-inch and larger inside diameter, deflections shall be determined by a method submitted to and approved by the Engineer. If a mandrel is selected, the minimum diameter, length and other requirements shall conform to the dimensions and requirements stated above.

All Sewers and storm drains constructed of flexible pipe shall be tested for vertical deflection no less than 30 Days after trench backfill and compaction have been completed. No diameter of the installed pipe shall exceed a tolerance of more than 5 percent for 12 inch and smaller nominal diameter pipe, and by no more than 3% for all larger than 12 inch nominal diameter pipe and less than or equal to 30 inch nominal diameter pipe. For pipes less than or equal to 30 inches nominal diameter, a mandrel shall be pulled through the pipe by hand to ensure that the maximum allowable deflection has not been exceeded. Prior to use, the mandrel shall be measured, inspected for roundness, and certified as being sound and accurate. A Manufacturer's Certificate of Compliance stating the mandrel to be used meets these Specifications, shall be submitted to the Engineer at least 1 Working Day prior to the test. The use of an uncertified mandrel or a mandrel altered or modified after certification will invalidate the test, and a 2 Working Day advance notification to the Engineer of a retest with a certified mandrel shall be complied with. If the mandrel fails to pass through the pipe, the pipe will be deemed overdeflected and unacceptable.

Testing shall be conducted on a manhole-to-manhole basis after the line has been thoroughly flushed with water. If testing reveals an overdeflected pipe, it shall be uncovered and, if not damaged from overdeflection or from excavation activities, the pipe may be corrected and reinstalled. If the pipe requires repair, the Contractor shall submit the proposed repair to the Engineer for approval at least 3 Working Days before making the repair. The Contractor shall also provide prior to performing the repair, a Manufacturer's Certificate of Compliance stating that the overdeflected pipe as repaired shall acceptably perform as required by the Specifications. If no repair is recommended, the Contractor shall state that the pipe requires no repair including the reason why the pipe requires no repair, and shall also provide a Manufacturer's Certificate of Compliance stating that the pipe without repair shall acceptably perform as required by the Specifications. Any pipe damaged beyond reasonable repair, due to overdeflection or from any other cause, shall be uncovered and removed from the Project Site and replaced with a new pipe at no cost to the Owner. Pipe large enough for a person to work inside it may be accepted on the basis of direct measurements rather than using a mandrel. The Contractor shall submit a method for making deflection measurements including the measurement device(s), how the measurement device(s) is verified as providing reasonably repeatable results, how "mark points" will be placed on the pipe for the deflection measurements, and how the measurement data at each test location is presented to demonstrate that any indicated deflection is within the tolerances allowed. The Engineer reserves the right to determine the number of measurements and the orientations of each measurement at each test location. The minimum number of orientations per test location shall be 3 in equal angle projections (3 orientations at 0°, 60°, and 120°). The Engineer also reserves the right to determine the number of test locations. The minimum number of test locations on any single section of pipe shall be no less than 2, and in no case shall there be less than 3 pipe sections tested, and no less than 3 pipe sections tested per any 100 foot length of pipeline.

The mandrel shall:

1. Be a rigid, nonadjustable, odd-numbering-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter;
2. Have a minimum diameter at any point along the full length as follows:

Minimum Mandrel Diameter (inches)	Pipe Material	Nominal Size (Inches)
5.619	PVC ASTM D 3034 (SDR 35)	6
7.524		8
9.40		10
11.91		12
13.849		15
16.924	PVC ASTM F 679 (T-1 Wall)	18
19.952		21
22.246		24
25.29		26
28.502		30

3. *Be* fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe Material, *Material* specification, nominal *pipe* size, and mandrel OD (e.g., PVC, D 3034, 8 inch, 7.524 inch); and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

7-17.3(4)I TELEVISION INSPECTION

Once during the final inspection process, the Contractor in the presence of the Engineer, shall videotape the interior of all Sewer and Storm Drain pipe 6 inches through 48 inches in diameter to determine acceptance of this work. Side Sewer, catch basin and inlet connection pipe, and other non-mainline pipe will not require videotaping; however, the cameral shall stop at and videotape all connections looking into the pipe connection as best as can be done. The Contractor shall notify the Engineer at least 3 Working Days in advance of the videotaping, and shall have completed mainline cleaning and pressure testing of the pipe prior to videotaping. Pipe larger than 48 inches in diameter will be inspected visually by the Engineer after cleaning

and testing. Videotapes shall be furnished to the Engineer within 10 Working Days of the television inspection, and shall become the property of the Engineer.

Videotaping shall be performed prior to allowing mainline flow into the pipe from upstream sources. Upstream bypass, when used, shall accommodate television inspection as necessary to afford full visibility of pipe inverts (see Section 7-17.3(2)K).

Videotaping shall be accomplished using a 360-degree radial view color television camera (also known as "pan and tilt") with a mechanical footage counter, and shall have a light source providing adequate illumination acceptable to the Engineer. The camera shall be centered in the pipe invert to insure that the crown, invert, pipe connections and sides of the pipe are fully visible.

The videotapes shall be Standard Grade, 60-minute VHS tapes taped at SP speed. Each videotape shall be labeled with the Project name, Street *name, Drawing sheet number, vault plan number listed on the Drawings, the starting point and ending point (MH number to MH number preferred), the direction (upstream or downstream) the camera traveled in the pipe, and a unique identification number with the numbers on all videotapes of the Project being in consecutive sequence. Videotapes acceptable to the Engineer shall be of a quality which completely and clearly shows each joint and pipe connection, by reasonably viewing into each pipe connection, by being clear, and by having sufficient illumination to reasonably distinguish detail. Each videotape shall contain the video inspection of only one continuous run of pipe between consecutive manholes (the "run").*

Videotape not meeting the requirements of this Specification will be rejected. Upon Written Notice of rejection, the Contractor shall promptly conduct a second television inspection and submit an acceptable videotape at no additional or separate cost to the Owner.

Should video inspection reveal defective work, the Contractor shall, upon Written Notice from the Engineer, correct said defects pursuant to Section 7-17.3(4)A1. An additional television inspection shall then be taken of the corrected pipe run to verify acceptance at the sole expense of the Contractor. This procedure shall continue until acceptance of the corrected pipe run by the Engineer.

The Contractor shall not repair pipe or pipe joints which have failed a test specified in Sections 7-17.3(4)B or C or D or E until a written outline of the method and procedure of repair is submitted to and approved by the Engineer.

Six to eleven months after the Physical Completion Date, the pipelines may, at the option of the Engineer, be re-videotaped. Videotaping may be done by Owner's forces or, at the Engineer's option, by the Contractor. The Contractor shall schedule the re-videotaping within 10 Working Days after the date of Written Notice by the Engineer. This additional videotape will then be compared with the videotape made at final inspection to determine whether or not any changes have occurred in the condition of the pipe. Should there be evidence of inconsistencies as compared to the videotape of the original installation which warrant replacement or repair, the Contractor shall, upon Written Notice of the Engineer, correct those defects pursuant to Section 1-05.10. After the necessary corrections have been made by the Contractor, the corrections shall be verified acceptable by additional television inspection at the Contractor's sole expense.

7-17.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Extra Excavation" will be by the cubic yard of Material actually removed beyond the standard trench neat lines shown on Standard Plan nos. 284 and 285.

Measurement for "Bedding, (Class), (Size) Pipe" for Sewer, Culvert, and Storm Drain as shown on Standard Plan no. 285, and for Water Main as shown on Standard Plan no. 350, will be by the linear foot of pipe actually installed. For Sewer and Storm Drain, measurement will be from center to center of standard manholes or to the inside face of other Structures. For Water Main, measurement will be to inside face of Structure, to end of pipe, or to centerline of connecting tee. Class D bedding will not be measured.

Measurements for "Pipe, (Use), (Material), (Class), (Size)", for "Steel Casing Pipe, (Class), (Size), (Underground Construction Method)", and for "Pipe, (Material), (Class), (Size), (Underground Construction Method)" will be by the linear foot of pipe actually installed and successfully tested, and shall be along the centerline of the pipe through the tees or wyes with the exception of pipe ending at a tee or wye. Measurements will be to the center of new manhole or rechanneled existing manhole; or to the inside face of Structure or existing manhole not rechanneled; or to the end of pipe where it meets a manhole stub; or to a wye, or to a tee whether with stub or cut-in. Measurement will be to the nearest 0.1 foot. *See Standard Plan no. 010. All incidental to pipe measurement will be measured within Standard Plan no. 284 neatline limits.*

No measurement will be made for trench excavation, trench backfill, and selected Material for trench backfill, except for foundation Material, extra excavation and imported backfill Material.

Measurement for foundation Material will be by the cubic yard of Mineral Aggregate required to fill the void made by extra excavation and shall be based on neat line width of trench and depth and length as computed by the Engineer.

Measurement for "Mineral Aggregate, (Type)" trench backfill will be by the cubic yard based upon the neat line trench pay width as specified in Section 7-17.3(1) and the Standard Plan, or other neatline dimensions when designated by the Engineer. Imported Mineral Aggregate used beyond these neat line limits shall be at the Contractor's sole expense.

Measurement for "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot" and for "Support System" will be by the square foot. The square foot quantity equals the area of a vertical plane through the pipe centerline, calculated by multiplying the average of the trench end depths by the length of trench between points four or more feet deep. Depth is measured from existing surface grade at the time of excavation to pipe invert. No measurement will be made for

support system beyond designated locations indicated in the Contract where the Contractor determines a support system is required. See Section 2-09.4 for measurement of a trench safety system where a trench is created in a structural excavation.

Measurement for "Temporary Sewer Bypass" will be by lump sum.

Measurement for "TV Inspection" will be for the linear feet of installed 6"-48" diameter mainline pipe videotaped once during (1) final inspection and (2) such re-videotaping done six to eleven months after the Physical Completion Date. Measurement will be made along the pipe centerline through tees from (1) center to center of new or rechanneled manholes, or (2) to the inside face of Structures or manholes not channeled, or (3) to the end of pipe where it dead ends beyond manholes.

7-17.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-17 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Extra Excavation",** per cubic yard.

The Bid item price for "Extra Excavation" shall include all costs for the work required to remove; haul and dispose of the excavated material.

2. "**Bedding, (Class), (Size) Pipe",** per linear foot.

The Bid item price for "Bedding, (Class), (Size) Pipe" shall include all costs for the work required to furnish and install bedding to the cross section shown in Standard Plan no. 285. Cost of Class D bedding shall be included in the Bid item for the pipe Bid item and therefore no separate or additional payment will be made for Class D bedding.

3. "**Pipe, (Use), (Material), (Class), (Size)",** per linear foot.

The *Bid item price* for "Pipe, (Use), (Material), (Class), (Size)" shall include all costs for the work required to furnish and install the pipe of the type and size specified, and including the following:

a. trench excavation (except "Extra Excavation"); haul, stockpile, backfill, and compact *suitable* native Material backfill,
b. *handling; hauling, storage, removal; off-site disposal of excess suitable and unsuitable excavated native material, or hauling, storage, placement of suitable excess excavated native material or selected Material elsewhere on the Project except where designated for embankment construction,*
c. dewatering,
d. required trench excavation, backfill, and compaction,
e. cleaning and testing per Section 7-17.3(4),
f. Class D bedding,
g. pipe coupling, and
h. removal and disposal of existing pipe within trench neatline limits when pipe replacement is called for in the Contract.

Costs for the dewatering of the trench shall be considered as included in the Bid item prices for the applicable pipe Bid items.

All costs in connection with excavating test pits and for standby time during field density tests for compaction shall be considered as included in the Bid item prices for the applicable pipe Bid items.

Unauthorized excavation below the established trench grade shall be made good by the Contractor at the sole expense of the Contractor by providing, placing and compacting suitable bedding Material to the proper grade elevation.

The work of cleaning and testing, except TV inspection, and furnishing caps and plugs for the tests shall be considered as included in the Bid item prices of the pipe Bid items.

Costs for the work required in proof testing the pipe shall be considered included in the Bid item prices for the appropriate pipe Bid items.

Any damage resulting from testing of the Sewers and appurtenances specified in Section 7-17.3(4)A shall be made good by the Contractor at the Contractor's sole expense.

All costs of determining the source or sources of leakage and the cost to repair or replace the Sewer found unacceptable as specified in Section 7-17.3(4), shall be borne by the Contractor.

If the pipe fails the deflection test as specified in Section 7-17.3(4)H, all costs to locate and repair the failed sections and retest the pipe shall be borne by the Contractor.

All costs for the work required to furnish and install joint coupling devices as specified in Section 7-17.3(2)F shall be considered as included in the Bid item prices for the pipe Bid items.

4. *"**Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)",** per linear foot.*

The Bid item price for "Casing Pipe, (Material), (Class), (Size), (Underground Construction Method)" shall include all costs for the work required to furnish and install casing pipe as specified in Section 7-17.3(2)J, including installation and removal of shoring of the jacking pit.

5. "**Pipe, (Material), (Class), (Size), (Underground Construction Method)",** per linear foot.

The *Bid item price* for "Pipe, (Material), (Class), (Size), (Underground Construction Method)" shall include all costs for the work required to furnish and install the pipe as specified in Section 7-17.3(2)J.

6. "**Tee, (Material), (Size)",** each.

The *Bid item price* for "Tee, (Material), (Size)" shall include all costs for the work required to furnish and install the tee including plug when required.

7. "**Tee, (Size), Cut-In Existing (Material) Pipe**", each.

The Bid item price for "Tee, (Size), Cut-In Existing (Material) Pipe" shall include all costs for the work required to furnish and install the tee as specified in Section 7-17.3(2)C3. If Drainage and Wastewater Utility installs a pipe with a tee, no payment will be made.

8. **"Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot**".

The minimum Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot" shall be forty cents ($0.40) per square foot. Should the Contractor determine that the cost for this work is greater than $0.40 per square foot, the Contractor may Bid a higher Bid item price by crossing out the minimum Bid item price and extension shown in the Bid Form, writing in a higher Bid item price and extension in the Bid Form, and initialing the change. Should a Contractor write in a Bid item price less than the minimum $0.40 per square foot, the $0.40 Bid item price shall govern and become a part of the Bid.

The Bid item price for "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot" shall include all costs for the work required to provide, construct, maintain and remove safety systems for trench excavations equal to or exceeding a depth of 4 feet as specified in Section 7-17.3(1)A7a. All costs for support system beyond the designated locations in the Contract where a support system may be required as determined by the Contractor shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot".

9. **"Temporary Sewer Bypass",** per lump sum.

The Bid item price for "Temporary Sewer Bypass" shall include all the work required to bypass Sewer flow around the construction work.

10. "**Television Inspection",** per linear foot.

The Bid item price for "Television Inspection" shall include all costs for the work required for CCTV inspection of all Sewer and Storm Drain pipe 6" through and including 48" diameter and furnishing an acceptable videotape of a Sewer or Storm Drain pipe to the Engineer. Payment will be for one complete videotaping session made during (1) the final inspection process and (2) one complete re-videotaping, if videotaping is requested by the Engineer, six to eleven months after the Physical Completion Date. Costs for additional videotaping sessions and tapes necessary to verify corrections or replacement of pipe or done solely for the Contractor's convenience shall be borne by the Contractor.

11. "**Support System",** per square foot.

The Bid item price for "Support System" shall include all costs for the work required to furnish, install, maintain, and remove the support system for trench excavations at the designated locations on the Drawings as specified in Section 7-17.3(1)A7b. No separate or additional payment for "Support System" will be made for the use of support system as part of the Contractor determined trench safety system outside of the locations specified on the Drawings and all costs for such support system shall be included in the Bid item price for the Bid item "Safety Systems in Trench Excavation, Minimum Bid = $0.40 per Square Foot".

12. **Other payment information**.

See Section 2-09.5 for payment of a trench safety system where trench conditions are created in a structural excavation.

Where unauthorized excavation has been made which increases the established trench depth beyond 4 feet, the Contractor shall meet the requirements specified for Trench Safety Systems in Section 7-17.3(1)A7a at no additional cost to the Owner.

Payment for imported Material when ordered in lieu of native backfill Material by the Engineer will be paid as "Mineral Aggregate, (Type)", or other imported Material acceptable to the Engineer.

Foundation Material when required will be paid as "Mineral Aggregate, (Type)" per cubic yard, per Section 4-01.5.

Where the Engineer determines that the existing foundation is unsuitable, and foundation Material specified by the Engineer is not in the Contract and no Bid item for "Mineral Aggregate, (Type)" is included in the Bid Form, payment will be made in accordance with Section 1-04.1(2).

The cost for the Owner's labor and Equipment for the videotaping during the final acceptance process and the videotaping 6 to 11 months later to recheck the pipe condition will be borne by the Owner unless additional videotape inspection is necessary to verify corrections or replacement of deficient pipe. The cost of additional television inspection, and cleaning in preparation for television inspection, to verify repairs or replaced pipe shall be borne by the Contractor. The Contractor shall also be responsible for all costs incurred in any television inspection performed solely for the benefit of the Contractor.

If the Contractor calls for an initial TV inspection, and the pipe is not clean or has so many deficiencies that the line cannot be fully inspected, the reinspection will be charged to the Contractor, and the cost withheld from money due to the Contractor.

The Contractor shall provide all necessary water for construction and testing purposes, according to the requirements of Section 2-07.

If the Contractor damages or undermines the adjacent improvements outside the maximum pay width as described in Section 7-17.3(1)A1, he shall be required to remove and replace those areas at no cost to the Owner.

No separate or additional compensation will be made for submittals, or for Material used in the jacking operations or for the cost of the backfilling operations, including compaction.

Any Material that becomes unusable due to the Contractor's failure to take adequate measures to provide protection from moisture shall be replaced, at the Contractor's expense, with same or substitute Material acceptable to Engineer.

Payment for plugging pipes will be in accordance with Section 2-02.5.

Payment for selected Material used for embankment compaction will be in accordance with Section 2-03.5.

The Contractor shall, at the Contractor's sole expense, provide pipe of increased strength classification or place a class of bedding of higher load bearing capacity, as required by the Engineer, when the maximum trench width specified in Section 7-17.3(1)A1 is exceeded by the Contractor without prior written approval of the Engineer. The Contractor shall furnish and install any approved imported backfill Material required outside the trench neat line limits.

SECTION 7-18 SIDE SEWERS

7-18.1 DESCRIPTION

Section 7-18 describes work consisting of excavation, shoring, foundation preparation, bedding, jointing, backfilling, compacting and testing for the construction of side *Sewer*s.

A side Sewer is considered to be that portion of a Sewer line that is constructed between a main Sewer and a residence or other buildings, and shall be in compliance with applicable side sewer ordinance. All privately owned and operated drainage control facilities or systems, whether or not they discharge to a public drainage control system, shall be considered side Sewers and shall be subject to Title 21 of the Seattle Municipal Code. It does not include any of the internal piping or connecting appurtenances, the installation of which is controlled by a municipal code, ordinance or regulation.

The general requirements for construction of Sewers in Section 7-17 of these *Standard* Specifications shall apply to construction of side Sewers as well unless they are inconsistent with any of the provisions of this Section. These Specifications apply to all side Sewers on *Seattle's* Rights of Way.

Trench excavations over 4 feet in depth shall comply with the trench safety requirements of Section 7-17.3(1)A7a.

7-18.2 MATERIALS

Materials shall meet the requirements for the following Sections:

Joints	9-04
Pipe	9-05

All pipe shall be clearly marked with type, class, date of manufacture, location of manufacturing plant, and/or thickness, as applicable. *Marking* shall be legible and permanent on the outside surface of the pipe*, and able to withstand normal wear due to handling and storage*.

Approved jointing shall be flexible gasketing.

Flexible gasketing shall be construed to include rubber, synthetic rubberlike and plastic Materials specially manufactured for the joint, pipe size, and use intended and shall be furnished by the manufacturer of the pipe to be used.

Tees, wyes, bends, couplers, adapters, and transition sections shall conform to the requirements of this Section.

Mortared joints will not be allowed.

7-18.3 CONSTRUCTION REQUIREMENTS

7-18.3(1) SIDE SEWER CONSTRUCTION

7-18.3(1)A GENERAL

Side Sewer work shall be performed by a registered side Sewer contractor in accordance with SMC 21.16.060.

Side *Sewer*s shall be constructed with a maximum joint deflection not to exceed the manufacturer's printed recommendations and in no case shall exceed 2 inches per foot at any joint. Larger changes in direction shall be made by use of standard 1/8-bends.

Side *Sewer* construction shall conform to Standard Plan no. 283 and all applicable ordinances or regulations with respect to Equipment, protective measures, size of pipe, depth of cover, number of users per pipe, permissible connections, inspection, and testing.

Side *Sewer* locations shown on the Drawings shall be subject to relocation in the field after construction starts. Regardless of the Drawing location, the Contractor shall place the tee or wye branch in the main Sewer line at the location designated by the Engineer.

The Engineer will stake and indicate the depth for the invert elevation of end pipe at the *Street* margin or property line.

Side Sewers shall be installed with existing, or with other Project proposed, Water Main and other underground utilities, in accordance with the clearance requirements specified in Section 1-07.17(2).

Side Sewer trenching shall be subject to the provisions of Section 7-17.3(1).

7-18.3(1)B *RESERVED*

7-18.3(1)C SIDE SEWERS SHOWN ON THE DRAWINGS

7-18.3(1)C1 PROTECTION OF EXISTING SIDE SEWER

When a new pipe *installation is indicated on the Drawings as* crossing above or beneath an existing side Sewer which is shown on the Drawings, it shall be the responsibility of the Contractor to protect the existing side Sewer from damage during the course of construction.

7-18.3(1)C2 REMOVE AND REPLACE EXISTING SIDE SEWER

When the Drawings call for removal and replacement of existing side Sewer, only new pipe shall be used to replace the removed pipe.

7-18.3(2) *EXCAVATION, FOUNDATION PREPARATION, BEDDING, AND BACKFILL*

Excavation, foundation preparation, bedding and backfill for side Sewers shall conform to the requirements of Section 7-17, except that no bedding in excess of that required to hold the pipe in true alignment shall be placed prior to inspection. The Contractor shall give the Engineer at least 2 Working Days advance notice before covering the side Sewer with bedding or backfill *for inspection and testing per Section 7-18.3(6)*.

7-18.3(3) PIPE INSTALLATION AND JOINTING

7-18.3(3)A GENERAL

Pipe installation and jointing, except as hereinafter provided, shall conform to the requirements of Section 7-17 and Section 21.16 of the Seattle Municipal Code.

7-18.3(3)B LINE AND GRADE

Side Sewers shall be installed to a line and grade between the main Sewer tee branch or wye branch and the Right of Way margin, so as to best serve the property relative to the following conditions, as *approved* by the Engineer:

1. Where a vacant property is level with or lower than the *Street* grade, the invert elevation of the proposed side Sewer end pipe at the Right of Way margin shall be 1 foot higher than the elevation of the crown of the main Sewer at the location of its tee or wye branch. See Standard Plan no. 283 for additional requirements.
2. Where an occupied property is situated at higher elevation than the *Street* grade and where the slope of the proposed side Sewer is steeper than 50%, the maximum elevation of the side Sewer at the Right of Way margin will be established by the Engineer with due consideration for placing the side Sewer below the invert of any proposed Storm Drain pipe, unless other conditions prevent it. The clearance between the invert of an existing storm Sewer and the crown of a side Sewer below it shall be not less than 6 inches. In either of these conditions, the end pipe of the side Sewer at the Right of Way margin shall be placed deep enough to accommodate at least 2-1/2 vertical feet of backfill between the crown of the pipe and established *Street* elevation at that point.
3. Where an occupied property is level with or lower than the *Street* grade, side Sewer pipe shall be installed on a grade not less than 2%.

7-18.3(3)C PIPE INSTALLATION

Bell and spigot pipe shall be installed with the bell end up grade. All pipe installation shall start and proceed up grade from the point of connection at the public Sewer or other starting point.

Pipe shall be installed in a straight line at a uniform grade between fittings.

7-18.3(3)D JOINTING

Where it is necessary to break out an existing side Sewer during construction due to grade conflict with a newly constructed pipeline, only new pipe shall be used in reconnecting the side Sewer. Where joints cannot be made due to dissimilar pipe Material or mismatched wall thickness, the Contractor shall use a flexible gasketed coupling to make a watertight joint. Couplings shall be those manufactured by “Romac”, “Smith-Blair” or approved equal for reinforced *concrete* pipes, and “Fernco” or approved equal for non-reinforced *concrete* pipes.

7-18.3(4) FITTINGS

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used.

The maximum deflection permissible at any one fitting shall not exceed the pipe manufacturer’s recommendation. The maximum deflection of any combination of two adjacent fittings shall not exceed 45 degrees (one-eighth bend) unless straight pipe of not less than 2-1/2 feet in length be installed between such adjacent fittings, or unless one of such fittings is a wye branch with a cleanout provided on the straight leg.

Side Sewers shall be connected to the tee, wye, or riser provided in the public Sewer where such is available, utilizing approved fittings or adapters. Where no tee, wye, or riser is provided or available, connection shall be made by core drilling and installing an approved insert or saddle tee as specified in Section 7-17.3(2)C2.

7-18.3(5) CLEANOUTS

Refer to Section 7-19.

7-18.3(6) INSPECTION AND TESTING

7-18.3(6)A INSPECTION

See Section 7-18.3(2). Side Sewer covered without Engineer inspection shall be exposed for inspection and all associated costs shall be at the sole expense of the Contractor.

7-18.3(6)B TESTING

All *newly installed* side Sewers, including runoff and downspout connections, shall be tested after backfill. Side Sewers that are reconstructed or repaired to a length of 10 feet or more shall be tested for watertightness in accordance with Section 7-17.3(4)B. Testing of newly reconstructed sections of side Sewers consisting of a single length of pipe will not be required. *Testing of existing side Sewers reconnected to the main line will not be required.* Testing shall be performed in the presence of the Engineer in accordance with Section 7-17.3(4).

All side Sewers constructed in conjunction with the main Sewer shall, for purposes of testing as specified in Section 7-17.3(4), have a 6-inch tee fitting placed at the point where the side Sewer crosses the *Street* or other public Right of Way margin. *The tee opening shall be positioned perpendicular to the side Sewer slope*.

When the new side Sewer is connected to a new main Sewer installed under the same Contract, and the side Sewer is not tested simultaneously with the test of the main Sewer, the Contractor shall furnish and place, at his own expense, an additional 6-inch tee in the first pipe out of the main Sewer tee, so that an inflatable rubber ball can be inserted for sealing off the side Sewer and thus permit separate tests.

When the new side Sewer is connected to an existing main Sewer, the Contractor shall furnish and place 2 test tees: one immediately adjacent to the main Sewer and a second where the side Sewer crosses the *Street* or right-of-way margin. Both test tees will be paid per Section 7-18.5.

The ends of side Sewers or test tee openings shall be plugged watertight with Materials and by method acceptable to the Engineer.

7-18.3(7) MISCELLANEOUS REQUIREMENTS

7-18.3(7)A PIPE AND CONNECTIONS

Side Sewer in Right Of Way or utility easement shall be not less than 6 inches in diameter unless otherwise specified *in the Contract*. Side Sewers on private property shall be not less than 4 inches in diameter. No roof drain, area drain, or subsurface drain shall be connected to a side Sewer which is connected to a separate main line sanitary only Sewer.

Roof drains or private service drains in areas of combined Sewer systems shall be run in a separate pipe to the property line before connecting into the side Sewer.

7-18.3(7)B PROXIMITY TO WATER SUPPLY LINES

Clearance between side Sewers and Water Mains shall be maintained as specified in Section 1-07.17(2).

7-18.3(7)C PLUGS

Unused side Sewer openings shall be closed with a watertight plug fastened in place, as approved by the Engineer.

7-18.3(7)D SEPTIC TANKS AND CESSPOOLS

No side Sewer shall be constructed through or adjacent to an existing cesspool or septic tank. If the conditions prohibit any other location, the Contractor shall abate the cesspool or septic tank by such means as the Engineer may direct, and by such payment as may be specified or agreed upon.

7-18.3(8) RESTORATION, FINISHING, AND CLEANUP

The Contractor shall restore and/or replace all pavement, curb, sidewalk, landscaping, *and* other disturbed surface improvements to their original or better condition in such manner as to meet the requirements of applicable sections of these Specifications. All surplus Materials and temporary structures, as well as all excess excavation shall be removed and the entire site of Contractor operations shall be left in a neat and clean condition.

When the course of Work requires entering private property, the Contractor shall comply with Section 1-07.24.

7-18.3(9) EXTENDING SIDE SEWERS INTO PRIVATE PROPERTY

Unless authorized by Section 21.16 of the Seattle Municipal Code, the property owners will not be permitted to extend side Sewers onto their property or connect fixtures thereto.

7-18.3(10) END PIPE MARKER

Location of side Sewers shall be marked by the Contractor at the property line by a 2-inch x 4-inch wooden stake 4 feet long buried in the ground a depth of 3 feet. The lower end shall have a 2-inch x 4-inch cleat nailed to it to prevent withdrawal of the stake. The exposed 1 foot shall be painted traffic white and the depth to the side Sewer or tee shall be indicated in black paint on the 2-inch x 4-inch. In addition, a length of 12 gauge galvanized wire shall be provided to extend from the plugged end of the side Sewer or tee. The upper end shall emerge at the stake, but shall not be fastened to it.

7-18.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Pipe, (Use), (Material) (Class), (Size)" will be to the nearest 0.10 foot along the pipe from the tee or wye of the main Sewer through tees, wyes and other fittings to the *Street* margin or Right of Way margin.

Measurement for trench safety system will be in accordance with Section 7-17.4.

7-18.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-18 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. **"*Pipe, (Use), (Material), (Class), (Size)*",** per linear foot.

The *Bid item price* for "*Pipe, (Use), (Material), (Class), (Size)*", shall include all costs for the work required to furnish and install the side Sewer pipe of the type specified, including the following:

a. Trench excavation (except "Extra Excavation"), haul, stockpiling, backfill and compaction of native Material;
b. removal and disposal of excess and/or unsuitable excavated native Material;
c. dewatering;
d. removal and disposal of existing pipe encountered in required trench excavation and backfill;
e. temporary bypass of sewage, including pumping,
f. cleaning and testing; and
g. Class D Bedding.

2. "**Tee, Test, (Material), (Size)",** per each.

The Bid item price for "Tee, Test, (Material), (Size)" shall include all costs for the work required to furnish, install, and remove as necessary the test tee.

3. **Other payment information**.

Payment for safety systems required for trench excavation work *will be* in accordance with Section 7-17.5.

Payment for Foundation Material will be in accordance with Section 7-17.5.

Payment for Tees will be in accordance with Section 7-17.5.

Payment for Bedding Class A, Class B and Class C will be in accordance with Section 7-17.5.

Pipe installed and covered without Engineer inspection shall be exposed for inspection at no cost to the Owner.

Remove and re-install side Sewer will be paid as "Pipe, (Use), (Material), (Class), (Size)".

SECTION 7-19 SEWER CLEANOUT

7-19.1 DESCRIPTION

Section 7-19 describes work consisting of the construction of sanitary Sewer cleanouts in accordance with Standard Plan no. 280 *and as indicated in the Contract*.

7-19.2 MATERIALS

All Materials incorporated into the total cleanout structure shall meet the requirements of the various applicable Sections of these *Standard* Specifications.

7-19.3 CONSTRUCTION REQUIREMENTS

A cleanout shall be provided for each total change of 90 degrees in grade or alignment. In no case shall the spacing of cleanouts exceed 100 feet. No cleanout will be required at the connection of the side Sewer to a riser on the public Sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side Sewer. Cleanouts shall consist of a wye branch in the side Sewer. All cleanouts located in the Right Of Way shall be extended to *finish* grade.

The extension of cleanouts to finish grade on private property is optional with the property owner. When extended to finish grade, cleanouts shall be full side Sewer diameter and shall be extended to a point not less than 6 inches nor more than 12 inches below the finished ground surface with a removable stopper which prevents passage of dirt or water. When specified *in the Contract*, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. An 1/8-bend shall be used to deflect the side Sewer upward as a cleanout where the terminal end of the side Sewer lies upstream from the last point of connection.

Pipe joints shall be the type specified in Section 7-17.3(2).

Trench excavation, bedding, and backfill requirements shall comply with the appropriate requirements of Section 7-17. The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. *Bedding around the wye and under the pipe connecting to the wye shall be thoroughly compacted. Otherwise, construction shall conform to the requirements shown on Standard Plan no. 280*.

7-19.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Sewer Cleanout, (Size)" *will begin at the wye branch and extend through the casting*, as shown on Standard Plan no. 280.

7-19.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-19 will be made at the Bid item price Bid only for the Bid item listed or referenced as follows:

1. "**Sewer Cleanout, (Size)",** per each.

The Bid item price per each for "Sewer Cleanout, (Size)" shall include all costs for the work required for furnishing and installing the wye, Sewer pipe, pipe bands, pipe plug, casting, and concrete collar.

SECTION 7-20 ADJUSTMENT OF NEW AND EXISTING UTILITY STRUCTURES TO FINISH GRADE

7-20.1 DESCRIPTION

Section 7-20 describes work consisting of adjusting new and existing manholes, catch basins, inlets, valve chambers, water meter boxes, handholes, and similar utility Structures encountered during the Work to a new grade elevation. The work shall include adjustment by removing or installing ring extensions; by removing and installing adjustment brick; by removing or adding a vertical riser section to the utility Structure; by removing and rebuilding a portion of the existing Structure; or by any combination of the preceding methods.

Publicly-owned utility Structures shall be adjusted to finished grade by the Contractor. Privately-owned utilities are generally in the *Street*s and Road Rights of Way pursuant to franchises or to rights claimed under the laws of the United States of America, or the State of Washington and, therefore, these utility agencies are responsible for all adjustments and relocations of their own facilities. The Contractor shall schedule the Work so that utility adjustments by others can be accomplished without undue delay.

The requirements of Section *7-20* apply to utility Structures constructed from precast concrete sections, masonry brick or blocks, and cast-in-place concrete.

7-20.2 MATERIALS

Material used in the adjustment of existing utility Structures shall meet the requirements for new construction specified in the *Specification* Section applicable to the item being adjusted.

Adjustment ring extensions shall meet the requirements of Section 9-12.8 and Standard Plan no. 231.

Epoxy used to secure manhole castings for ring extensions to existing frames shall be per epoxy manufacturer's recommendations for the material application. The Contractor shall submit at least 3 Working Days in advance, a Manufacturer's Certificate of Compliance and catalog cut stating the proposed epoxy provides *acceptable* bonding performance for the intended application.

7-20.3 CONSTRUCTION REQUIREMENTS

7-20.3(1) ADJUSTMENT OF MANHOLES, CATCH BASINS, AND SIMILAR STRUCTURES

7-20.3(1)A GENERAL

See Section 8-13.3(1) for coordination and notification requirements regarding survey monumentation.

The Engineer will establish approximate grade elevation for the tops of existing utility Structures requiring adjustment. The final alignment and grade elevation shall be established from adjacent roadway surfaces, forms, or such offset hubs as may be provided by the Engineer.

Except where adjustment is to be made by ring extension, the Contractor shall remove the pavement around the casting; remove the casting and install or remove leveling or adjustment brick or block; or shall excavate around the utility structure, remove a portion of it as necessary and rebuild the structure to meet the new grade elevation. Pavement removal shall be kept to the minimum amount required to facilitate the adjustment. Adjustment of drainage Structure to finished grade elevation, by whatever method, shall result in a finished Structure meeting the requirements for new construction as specified in Section 7-05.3(1)P, except inlets which shall comply with Section 7-05.3(2)D. The overall distance between the top of the casting to the bottom of the adjustment brick shall be not more than 26 inches.

Where a Water Main casting adjustment is required and the concrete pavement or concrete rigid pavement base is to be made thicker, the Contract will specify whether or not a new Water Main casting is required. If a new Water Main casting is required, the Contractor shall comply with the requirements in Section 7-20.3(5); otherwise, adjustment of Water Main castings shall be by either brick or concrete block. The adjustment of Water Main castings with ring extensions will not be allowed.

When a ring extension is specified *in the Contract*, it shall be epoxied securely to the existing frame. *All frame and ring extension surfaces to receive the epoxy shall be thoroughly cleaned with a wire brush prior to the application of epoxy*.

When adjustment is made by adding or removing leveling bricks, all joints in the bricks shall be filled with mortar and the casting seated in mortar on the top brick course.

After the utility Structure has been adjusted to grade, and the Structure made watertight by plastering with a mortar cement, all voids around the Structure shall be backfilled and compacted with imported Mineral Aggregate *Type 17*. The casting shall then be secured in place with a tapered layer of concrete or asphalt, as applicable.

The Contractor shall adjust to finish grade, water meter boxes encountered in the planting strip and sidewalk area.

Should adjustment to a water meter box necessitate adjustment or relocation of the water meter, the Contractor shall notify the Engineer at least 3 Working Days in advance and the water meter will be adjusted or relocated by SPU Water Operations. The Contractor shall then make final adjustment of the meter box.

7-20.3(1)B UNPAVED STREET GRADING PROJECTS

New manholes, catch basins and similar Structures constructed in conjunction with *Street* grading Projects which are to be surfaced with gravel or crushed stone shall be constructed to a point approximately 8 inches below the Subgrade and covered with a temporary wood cover. Existing manholes encountered shall be cut off and covered in a similar manner. The Contractor shall carefully reference all manholes so that they may be easily found upon completion of the *Street* work.

After placing the gravel or crushed stone surfacing, the utility Structures and utility castings shall be constructed to the finished grade of the roadway surface. Excavation necessary for bringing utility castings to grade shall center about the utility structure and be held to the minimum area necessary. After completion of the utility structure adjustment, and after the structure is made watertight by plastering with mortar cement, the void around the manhole shall be backfilled with imported Mineral Aggregate *Type 17* and thoroughly compacted.

Where bituminous surface treatment is to be placed, the manhole castings shall be installed from 1/2 inch to 1 inch higher than the rock surfacing so that the top of the casting matches the finished roadway surface.

7-20.3(1)C CEMENT CONCRETE PAVING PROJECTS

Manholes, catch basins and similar Structures shall be constructed or adjusted in the same manner as outlined in Section 7-20.3(1)A except that the final adjustment shall be made and the cast iron frame set after the forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

All Standard Plan nos. 230 and 351 castings (manholes and valve chambers) installed in and requiring new concrete pavement or rigid concrete base pavement, shall comply with the reinforcing requirements of Section 5-05.3(9).

See Section 7-20.3(1)A for Water Main casting adjustment requirements.

7-20.3(1)D ASPHALT CONCRETE PAVING PROJECTS

Utility Structures requiring adjustment *of frames* to match finish grade shall be adjusted prior to the start of the final paving operation.

The tops of existing utility Structure frames shall be raised or lowered to match the finish grade. Immediately after adjustment of the frame to finish grade in lanes that are to remain open to Traffic, the Contractor shall install temporary asphalt transition tapers around the Structure frame to prevent a nuisance to Traffic. The Contractor shall maintain the asphalt tapers and shall furnish, install, and maintain warning signs and barricades in accordance with Section 1-07.23 and Section 1-10. The Contractor shall remove the asphalt tapers immediately prior to the start of paving operations.

Inside surfaces of adjusted Structure *frame and bricks or rings* which are disturbed or damaged by the adjustment, as well as the new adjustment area, shall be mortared to give a smooth, watertight surface.

7-20.3(1)E ASPHALT RESURFACING PROJECTS

Adjustment of manholes, catch basins, and similar Structures on asphalt resurfacing Projects shall meet the requirements of Section 7-20.3(1)D.

7-20.3(1)F STORM AND SANITARY SEWER OR WATER PROJECTS

Manholes, catch basins, gate valve Structures and other similar type Structures being constructed in conjunction with Sewer or water Projects on improved Streets shall be brought to final grade as outlined in these *Section 7-20* Specifications.

7-20.3(1)G ESTABLISHMENT OF GRADE FOR TOP OF MANHOLE

The Engineer will establish the grade for top of manholes, catch basins and similar Structures; however, these grades will be approximate only. The Contractor shall allow adjustment of frame and frame extensions in accordance with the Standard Plans. The Engineer assumes no responsibility in this regard, except when the final grade is set.

7-20.3(2) ADJUSTMENT OF INLETS

The final alignment and grade of frames for new and old inlets to be adjusted to grade shall be established from the forms or *from* adjacent pavement surfaces. The final adjustment of the inlet *frame and frame extension* shall be performed in similar manner to that described for manholes. On asphalt concrete paving Projects using curbs and gutters, that portion of the frame not embedded in the gutter section shall be solidly embedded in concrete. The concrete shall extend a minimum of 6 inches beyond the edge of the *frame* and shall be left 1-1/2 inches below the top of the frame so that the wearing course of asphalt concrete pavement butts against the frame. The existing concrete pavement and edge of the casting shall be painted with hot asphalt cement.

Adjustments in the inlet structure frame and frame extension shall be made in the same manner and of the same Material as that required for new inlets. The inside of the inlet frame and frame extension shall be plastered smooth.

7-20.3(3) ADJUSTMENT OF MONUMENTS, AND FRAME AND COVER

Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

7-20.3(4) ADJUSTMENT OF VALVE BOX CASTINGS

Adjustment of valve box castings and Water Main castings shall be as specified in Sections 7-20.3(1)A and 7-20.3(5).

7-20.3(5) FURNISHING CASTINGS

Where adjustment of existing utility Structures is required and the Drawings indicate that the existing castings be replaced, the Contractor shall furnish new castings of the type specified on the Drawings with the exception of Water Main castings. Water Main castings requiring replacement will be furnished by SPU Water Operations. Casting shall include frame

and grate, or ring and cover unless the Contract specifies otherwise. Salvaged castings shall be cleaned and delivered as specified in Section 2-02.3(7).

7-20.3(6) ADJUST BY SHAFTING

Adjustment of existing utility casting and Structure shall be by shafting when the casting remains the same and one of the following conditions exists:

1. The casting is to be raised, resulting in a total depth of the adjustment brick zone greater than the maximum allowable as indicated on the Standard Plans; or
2. The casting is to be lowered more than the depth of the existing adjustment brick or in excess of 16 inches.

Work required shall include excavation, removal of the existing frame and cover, leveling bricks, cone section or flat slab of the utility structure. The Contractor shall add to or remove from the utility structure as appropriate, the vertical riser section having the least dimension, unless otherwise indicated on the Drawings, to allow the structure to be adjusted to the new grade elevation. The cone section or flat slab shall be reinstalled, adjustment bricks installed, and the existing frame and cover reset. *The surrounding void shall be backfilled and compacted in accordance with Section 7-17.3(3).*

7-20.4 MEASUREMENT

Bid items of Work completed pursuant *to the Contract* will be measured as provided in Section 1-09.1, Measurement of Quantities, unless otherwise provided for by individual measurement paragraphs *herein* this Section.

Measurement for "Adjust by Shafting" will be by the vertical foot of adjustment, from original grade to finish grade.

7-20.5 PAYMENT

Compensation for the cost necessary to complete the work described in Section 7-20 will be made at the Bid item prices Bid only for the Bid items listed or referenced as follows:

1. "**Adjust Existing Manhole, Catch Basin or Valve Chamber**", per each.
2. "**Adjust Existing Inlet**", per each.
3. "**Adjust Existing Monument Frame and Cover**", per each.
4. "**Adjust Existing Valve Box**", per each.
5. "**Adjust Existing Handhole**", per each.

The Bid item price for "Adjust Existing (Item)" shall include all costs for the work required to adjust the existing utility casting from original grade elevation to finished grade elevation with or without removing or adding adjustment bricks.

6. "**Adjust Existing Manhole, Catch Basin or Valve Chamber With Ring Extension**", per each.
7. "**Adjust Existing Inlet With Ring Extension**", per each.
8. "**Adjust Existing Monument Frame and Cover With Ring Extension**", per each.
9. "**Adjust Existing Valve Box With Ring Extension**", per each.

The *Bid item price* for "Adjust Existing (Item) with Ring Extension" shall include all cost for the work required to furnish and install the required ring extension.

In the case where the Contractor is required to adjust a casting with ring extension as well as making an adjustment by removing or adding adjustment bricks, the Contractor will be compensated for the work under the Bid items "Adjust Existing (Item)" and "Adjust Existing (Item) with Ring Extension".

10. "**Adjust By Shafting**", per vertical foot.

The *Bid item price* for "Adjust by Shafting" shall include the costs for all work required to modify the existing structure and complete the adjustment to the grade elevation as specified.

11. "**Utility Casting, (Type)",** each.

The *Bid item price* for "Utility Casting, (Type)" shall include the costs for all work required to furnish and install new castings of the type specified *in the Contract* when existing castings are to be replaced.

When a manhole is required to be rebuilt to accommodate a new casting, the cost of the utility casting shall be included in the *price Bid for the* Bid item "Rebuild (Item)" per Section 7-05.5 where "item" is "manhole".

12. **Other Payment Information**.

Costs for adjustment to finish grade of water meter boxes excluding adjustment of the water meter itself; small castings other than inlet, catch basin, manhole, valve chamber, handhole, monument, and water valve box; hydrant valve castings; and private and other public utility castings requiring coordination with the private or public casting owner, shall be included in the Bid item prices for the applicable Bid items and no separate payment will be made.

Mineral Aggregate ordered as backfill in lieu of native Material will be paid as "Mineral Aggregate, (Type)".

Restoration of the roadway surface shall be in accordance with the applicable Section covering the work involved.

The costs for asphalt or cement concrete used to secure castings prior to paving shall be considered incidental to the Work and no separate payment will be made.

All work required to adjust castings of all newly installed or rebuilt utility Structures to finished Street grade shall be considered included in the Bid item prices of the Bid items for the appropriate type of utility Structure.

In asphalt resurfacing Projects, as specified in Section 7-20.3(1)E, all costs to remove the asphalt concrete and/or cement concrete base, will be considered included in the Bid item price of the Bid items of work for adjusting the specified Structures.